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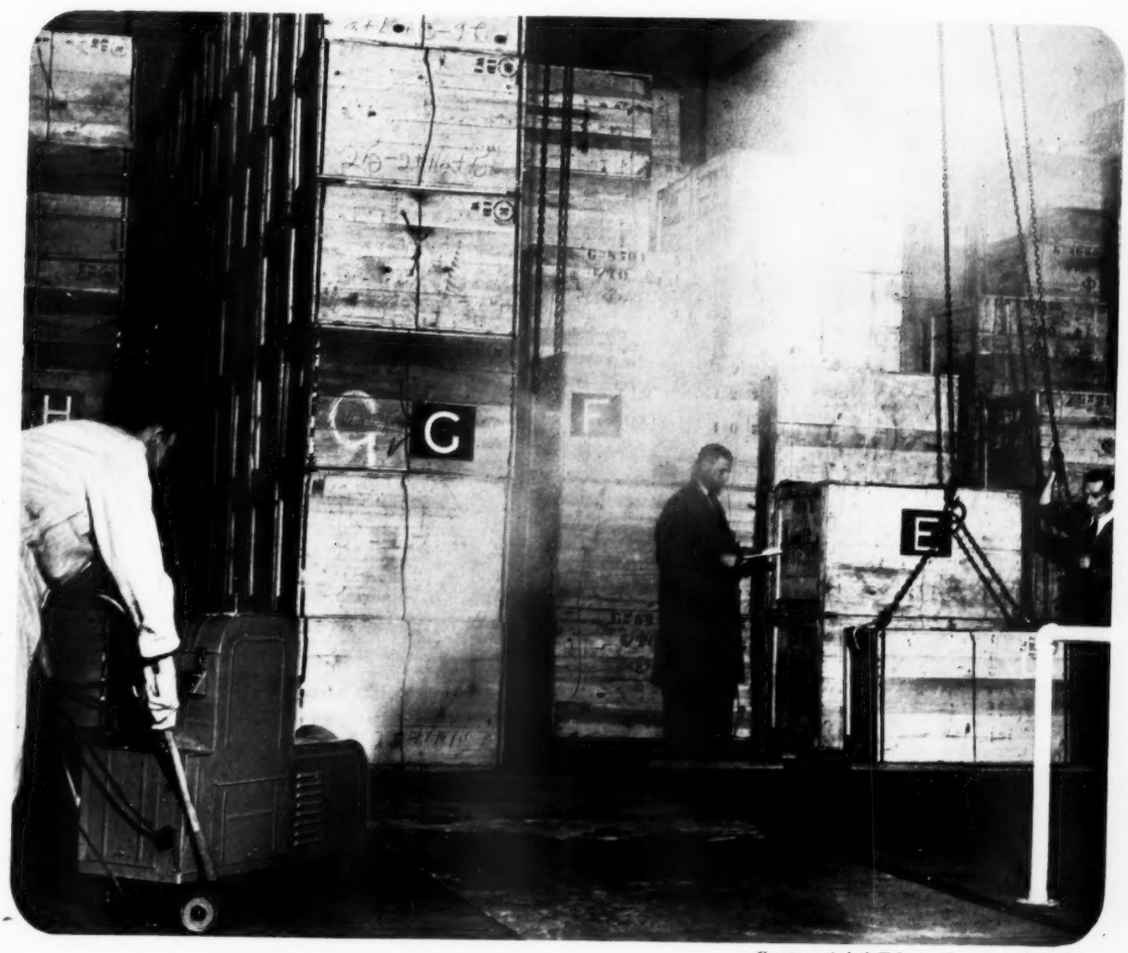

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VOLUME 6, No. 6 JUNE 1954

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WORLD CROPS

Editor: Sir Harold A. Tempany, C.M.G., C.B.E., D.SC., F.R.I.C.

Vol. 6. No. 6 — JUNE 1954

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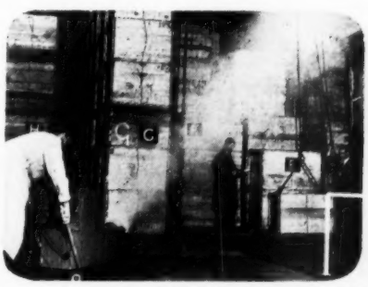

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Editorial Comment

Cocoa problems

OUR recent comments (see WORLD CROPS, 1954, **6**, 131) on the peak price of raw cocoa have been followed by dearer bars of chocolate in Britain and smaller ' nickel ' bars in the United States. The check to crop expansion in West Africa through swollen shoot and a variety of other diseases in the Western Hemisphere is not the only headache for chocolate producers. There is considerable criticism in America that the flavour of chocolate has been steadily declining for years, and this is not just another case of false memories of youth. A trebling of production and consumption in four decades has been accompanied with some falling-off in quality. When the expansive trend began, producers gradually shifted from the lower-yielding, high-flavour trees to trees which cropped more heavily but with a less flavourful bean. This has occurred to such an extent that, where at one time chocolate was based upon a 70% use of the ' flavour beans,' it is now based upon a 20% use. To quote a recent U.S. commentary, ' The change has been slow and manufacturers have juggled their recipes to hide the flavour decline, but they have about reached the end of the recipe rope.'

Another quality-degrading influence is poor preparation of the beans for the market. The pods must be cut open and the beans removed for a six-day fermentation before drying and roasting. If immature beans are included or if the fermentation process is casually controlled, the result is poor-quality cocoa. There is some suggestion that the high demand has tended to encourage a lessening of attention to these important quality influences.

Considerable research attention to these matters is being paid by the U.S. chocolate industry and by governments in the Western Hemisphere. Specialists have been sent from the U.S.A. to Brazil to improve bean processing. The Inter-American Institute of Agricultural Sciences at Costa Rica and the Ecuador Government's experiment station are trying to develop new tree varieties that will combine high-quality flavour with high yields. It seems highly important that the West African cocoa industry should not lag behind in paying attention to quality factors, even though at present it is mainly beset by the need to conquer the swollen-shoot menace. Ultimately the price-fixing influence that matters is the consumer's readiness to buy bars of chocolate.

Livestock grazing in forest areas

THE news that the first international conference to consider problems of livestock grazing in forest areas was held at the Rome headquarters of the Food and Agriculture Organisation, between March 29 and April 3, is intriguing. Invitations were sent to all the Organisation's 71 member governments and all parts of the world were represented at the meeting.

The value of such a meeting, which was emphasised by many delegates at FAO's conference last December, is to give consideration to technical means of increasing the yield of forage and livestock products as well as wood and other timber products. This approach provided a basis for developing general forest grazing policies.

It is only by making the most efficient use of all forest lands that production can reach the high levels now needed in every part of the world. Forage for grazing is an important part of the forest resources, but in many countries its abuse has resulted in serious erosion and deterioration of forests. The best use of forest range-lands has not been studied in many countries and the meeting considered the expansion of such studies. Attention was also paid to the education of those concerned at all levels in the use and management of forest land.

Besides discussion sessions, the delegates to the meeting had a field day, at the invitation of the Italian Government, to see work on forest grazing and mountain pastures in the Monte Subasio region. In concluding the meeting, delegates urged that principles of forest grazing policy should be further studied in all parts of the world, and that countries should take advantage of the technical assistance programme for advice in forest range management.

A full report of the meeting is being published shortly.

Soil conditioners

THE claims made for the poly acrylo nitriles as agents for the amelioration of soil structure continue to be the subject of a good deal of experimentation in various parts of the world and have also aroused a certain amount of controversy.

Among the places at which experimental work on this subject has recently been in progress is the agricultural experiment station in Nebraska, U.S.A., of which the results covering two seasons have recently been reported. The experiments included trials with various trade formulations of the sodium salt of hydrolysed poly acrylo nitrile in comparison with other soil treatments, including, notably, mulching with wheat straw at 2½ tons per acre.

The results indicated that the conditioner was effective in reducing erosion losses; when applied at the rate of 1,000 lb. per acre erosion loss was reduced by 44% compared with untreated soils, while when the rate was increased to 2,000 lb. and 4,000 lb. losses were reduced by 86% and 90% respectively. Water run off was reduced by only 14% on the plot receiving 1,000 lb. conditioner, while treatments of 2,000 lb. and 4,000 lb. of conditioner reduced run off by 41% and 51% respectively. On the other hand, it was found that wheat straw was considerably more effective than soil conditioners in preventing erosion and surface run off. Thus plots mulched with straw showed reduction of erosion losses by 98% and of run off losses by 89%.

The chemical treatment, however, shows greater promise of giving a lasting effect which so far has persisted well into the second season, whereas the straw mulch had largely decomposed and disappeared after 17 months; the results appear to suggest that straw mulches require to be renewed

annually. The soil on which these experiments were conducted was a silty loam on an 8.5% slope, the surface of which was very dry when the treatments were applied, and presumably distinctly liable to erosion loss.

These results make no mention of the economic aspects of the different treatments, but in common with indications elsewhere there appears no reason to doubt that the use of soil conditioners of the poly acrylo nitrile type is, to say the least of it, very doubtfully economic at present prices, which would have to be reduced very greatly before they can ever figure in agriculture in the open field, whatever may be their possibilities under controlled glasshouse conditions.

In any case, on these results one continues to suspect that the old-established and well-tried method of mulching with some suitable form of straw or trash may in all probability prove to be more effective and cheaper than these new soil conditioners, notwithstanding that they may have to be applied more frequently.

The tractor versus the horse

THE controversy between the advocates of mechanised cultivation and the defenders of the horse as the source of tractive power continues to rage. We have always held the view, despite castigation from some protagonists of the tractor who appear to regard the continued use of the horse or the tractive ox in agriculture as a sign of the existence of dangerous reactionary tendencies, that animal traction will continue to play indefinitely an important part. The tractor has undoubtedly rendered indispensable services and will continue to render them in an increasing degree in years to come as new ideas become accepted in the more backward regions of the world; nevertheless, the horse and the tractive ox, to say nothing of the donkey and even the camel in some Middle Eastern countries, still continue to play an essential role in agriculture and seem likely to continue to play it indefinitely.

The matter has been examined recently in an article in the spring issue of *The Times Agricultural Review* by Mr. John Barrington, who, taking a very balanced view of the question, points out that as long ago as 1767 one Francis Moore, who had then recently patented a steam engine for haulage and land cultivation, declared that horses were doomed and urged his friends to dispose of theirs ' before horse prices slumped.' In the ensuing 150 years this prophecy signally failed to verify itself, and it was not until two world wars had caused such an enormous wastage of horses that the tractor was able to step in and repair the wastage faster than it could be restored by breeding horses in war-torn Europe.

It is, of course, true that in the United Kingdom and the U.S.A. there was practically no horse wastage from enemy action, but in these two countries farmers were more mechanically minded, while in Britain the need for breaking land which had not been under the plough many years, combined with labour shortage, caused British farmers to turn to tractors eagerly. In Britain the numbers of horses have diminished by no less than 65% since 1939, and in the U.S.A. the position is similar, but in other European countries the fall has been much less, *e.g.* in France it is only 20%, in Sweden 30% and in Denmark 33%, while in Italy and Spain the number of horses is actually increasing.

The persistent reaction in favour of horse traction in some European countries was evidenced by the large number of horse-drawn implements which appeared at the recent Agricultural Machinery Exhibition in Paris, as recorded in our May issue. In the less developed countries one factor which is frequently operative against the introduction of mechanical cultivation is the difficulty of providing adequate supplies of spare parts and fuel at reasonable prices and of servicing machines when breakdowns occur.

In the latter part of his article Mr. Barrington himself points out that, as compared with a tractor, a team of horses has some advantages in that it causes less compaction of the soil, can work under wetter conditions, and breaks down much more rarely than does a tractor, while, in addition, it has the supreme advantage that it is divisible and the units can be used independently if need be, while it can subsist on farm crops and eliminates the need for imported fuel.

Costings, it appears, go to show that, except for jobs needing short hauls and long waits, the farm draught horse may not be so economical as a suitable tractor, especially on larger farms; on the other hand, mechanisation often involves an increase in the economic risks involved in farming by reason of the substantial expenditure needed. In the U.S.A., for example, a complete switch over to full mechanisation has often led to a shift in farm ownership from farmers themselves to centralised loan agencies.

In concluding his article Mr. Barrington poses the question whether British farmers have really lowered the cost of crop production by mechanisation and expresses the view that this may not always have been the case, adding that, in his opinion, the horse still has an important part to play.

Fungi and eelworms

A NEW approach to the eelworm menace is indicated in a recent communication to *Nature* (C. L. Duddington, 1954, **173**, 500). This visualises the destruction of eelworms and other nematodes by predaceous soil fungi as a significant means of control. Some will not look upon this as a new approach and will point out that the ultra-organic school has persistently emphasised ' natural ' means of pest control. However, the question is not the mechanism so much as the measurement of its real contribution. It is already known that predaceous fungi feed on nematodes, but as Kelvin, one of the great 19th-century scientists, always insisted, we know little or nothing about an effect or influence until it can be measured by a number. As a start, a soil survey embracing 49 different samples from various English sources, most of them from eelworm-infested land, has been carried out. Incubation experiments have found 82 cases of predaceous fungi existence in the 49 soils. Twenty different species were recognised, but two of these dominated the list for frequency of occurrence—*Arthrobotrys oligospora* and *Mycelium* 186. The former is known to be widespread as a natural organism, but the latter is a species of fungus only found in soil.

It does not follow, of course, that these two species are

the major enemies of nematodes. If high eelworm populations are the result of depression in predaceous fungi population, it is possible that species less frequently found in such soils are more deadly. How far is the growth or depression of these various species affected by such influences as soil *p*H? Is their distribution wider or more intense in soils not highly populated by eelworm? These are questions posed but not answered by the research so far reported. A study of many more soil samples is required before any evidence of value can be obtained.

The present research, at the Biological Laboratories of the Regent Street Polytechnic in London, is assisted by an Agricultural Research Council grant. It would seem to form an excellent example of the type of independent project that should receive support from State bodies such as the A.R.C. Most problems of pest control have their 'natural control' sector, but research seems mainly preoccupied with studying artificial means. Indeed, it seems strangely late—when the history of the eelworm menace is considered—for a practical study of these anti-eelworm fungi to be beginning only now.

Electricity for grain drying

THE artificial drying of grain is assuming increasing importance in many countries. The use of combine harvesters for reaping grain crops is causing an increasing demand for means of drying grain after reaping. The conventional way of performing this type of operation is by means of one of the numerous types of grain drier, but most of these are costly, take up considerable space, call for skill in their operation and are demanding in their requirements for fuel for operating.

At a recent 'school' on rural electrification organised by the British Electrical Development Association at the School of Agriculture of Nottingham University at Sutton Bonnington Mr. J. T. Taylor, of the Southern Electricity Board, called attention to the advantages offered by electricity in this connection and pointed out that the direct grain drier now has a serious competitor in the in-silo and in-sack types of electrical drier, which in Britain at least are increasing in number and giving satisfactory results.

In-silo driers take up very little space and are easy to install and to operate. Excellent control of the various heating elements is provided by means of individual switching. One great advantage of this type of installation is that it allows of bulk storage of grain without the necessity of installing an expensive type of conventional drier. In-sack driers can now be obtained direct from the makers and quoted direct to the farmer as a 'package installation.' One great advantage of this type is its compactness; it needs no separate building or fuel storage facilities and it can safely be left to work throughout the night unattended.

It is claimed that grain dried electrically by apparatus of this type is of superior quality. It is also claimed that electrical drying in this way enables considerable saving of labour inasmuch as if the layout is carefully arranged and the switchgear is suitably placed it is possible for one man to operate a complete plant from the intake pit to the placing and drying of the grain in the silos.

The cost of electricity used in drying operations naturally varies with the moisture of the grain under treatment, but for an in-sack installation an average consumption of 12 to 15 electrical units per ton per unit of moisture removed is a usual figure, while for in-silo installations a fair estimate has been placed at 15 to 20 units per ton per unit of moisture removed.

In all these circumstances it appears that electrical drying of grain by installations of this type may be well worth consideration wherever the need for it exists and where electric power is available at reasonable rates. It seems, also, that it may offer advantages as compared with the purchase of grain driers of the normal type.

Fertiliser legislation

AT a meeting of the Fertiliser Society held in London in March the requirements of the current Fertilisers Act were closely examined, and the outstanding point to emerge was the difficulty—and perhaps in theory the impossibility—of assessing the plant-food content of a large mass of material from one sample. Yet legislation stands upon this foundation. At about the same time a discussion on sampling in the United States was reported in *Chemical and Engineering News* (1954, **32,** 1016) and this highly relevant passage might well be quoted: 'What we are always seeking, of course, is the representative sample. If the product is homogeneous, any one sample is representative and sufficient. If the product is heterogeneous, the problem can become complex, and only a compromise solution is possible.' Many of the commonly used fertilisers are heterogeneous. The compounds obviously are, but it is perhaps less obvious that materials like superphosphate are also mixtures of several components. At the Fertiliser Society meeting Dr. John Manning proved beyond any reasonable doubt that these heterogeneous materials, today necessarily produced in mass-production flowlines, may well give 5 samples diverging significantly from mean composition although 95 other samples might be very close to the mean. In a broad sense this summarises his argument.

The legislative problem posed is no triviality. A modern plant turning out 50 or 100 tons of some specified product per day is nevertheless put to the test by the law on the basis of perhaps one sample taken out of a 1-ton or $\frac{1}{2}$-ton consignment. Every system of legislation allows the manufacturer certain margins for deviation. Ideally, those margins should be fairly small. Yet if they are set to protect the manufacturer from the risk of unfair prosecution through the random sample that is more divergent than the main bulk of the material, the margins must be appreciable. Perhaps in the American words quoted above 'only a compromise solution is possible.' But an entirely new approach to the problem might be more logical. It would not be impossible for the factory to be tested rather than its occasional consignments. At any time qualified inspectors could visit a factory and take *a series of samples* from the flowline. If a high proportion of these samples proved seriously divergent from specification, action could result; if, however, only one or two samples out of the total number

showed such divergence, it could be assumed that the factory was producing with as much accuracy as can be expected. In principle, this is not greatly different from the mechanism of milk legislation in Britain so far as fat content is concerned, where the farmer is entitled to justify divergence from standard by an 'appeal to the cow.' Such an approach to the problem of fertiliser legislation might well be better than widening the limits to cover the hazard of the odd, non-representative sample, for wider limits offer the temptation of deliberate dilution. Quite close limits of permissible variation would be fair, provided that an 'appeal to the flowline' was introduced as a manufacturer's right.

Agriculture in Rumania

INTEREST attaches to the agricultural position in all countries behind the Iron Curtain, and the following account from a correspondent affords some indication of the position in Rumania.

At the beginning of 1953 the livestock figures in Rumania had at last reached and passed the pre-war level; between 1948 and 1953 war losses and neglect had been made good, but, although this is an achievement, it cannot be considered adequate to meet the demands of an expanding internal economy and an increasing population. At the close of the same year measures intended to hasten improvements and expand production during the coming three years were approved, the aim being to produce, amongst other things, 600,000 tons of meat and fats, 451 million gallons of milk, 25,400 tons of wool and a minimum of 2,000 million eggs.

As part of this plan fodder plants are to be sown over an area of up to 3,200,000 acres and their yields increased by the use of fertilisers, etc. This involves bringing much unproductive meadow and marginal land under the plough and the work of the national machine and tractor stations will be geared to this undertaking. It is anticipated that larger harvests of the main spring crops—wheat, maize, potatoes, sugar beet and sunflower—will be reaped this year. The cultivation of maize has been improved by the use of selected seed. Potatoes are reported to have been planted on over 625,000 acres this year and a new method of planting has been introduced which is stated to be giving promising results. Sugar beet cultivation has received considerable attention also and the crop is being grown on a larger scale than formerly. It is also reported that mechanisation on farms is increasing.

It is stated that extensive agricultural research under the direction of the Bucharest Institute of Agronomy is in progress; one line of work for which successful results have been claimed aims at stimulating photosynthesis, and thereby plant growth in vegetable culture, by increasing the amount of carbon dioxide in the atmosphere by the combustion of natural gas. It is stated that rises of up to as much as 40% to 45% in yield have followed these efforts.

No details are provided and one wonders how far these optimistic accounts are actually borne out in practice. Certainly the lack of success which is reported to have followed efforts to collectivise farming on Soviet lines in Jugoslavia makes one wonder how far and why results should have been so much more favourable in Rumania, and whether the accounts may not, in fact, to an extent have been coloured by enthusiasm for Communist methods and ideals.

Antibiotics and plant disease

FOLLOWING upon the note under the above title in last month's WORLD CROPS it has been stated in the U.S. that the Food and Drug Administration will not attempt to regulate the use of antibiotics as sprays for crops. It seems that the view taken by FDA is that when antibiotics are thus used they must be classed as pesticides, and any responsibility for their use rests with the Department of Agriculture. Although this is by no means an 'all clear' for development work—for FDA remains interested in the control of contamination of all foodstuffs sold, raw or processed—it should certainly stimulate larger-scale experimental work by U.S. producers of antibiotics.

If there has been any background fear that the principle of using antibiotics as sprays would be opposed on the general ground that these substances should not incur any risk of indiscriminate distribution, doubt is now removed. If it can be shown that a particular antibiotic substance gives good and economic control over a bacterial or fungal plant disease, its commercial introduction will be subject to the same considerations as any other pest- or disease-controlling chemical — freedom from toxic risk in use and freedom from toxic risk through residues.

On the whole, toxic risks with these substances as crop sprays should be small. Only recently Sir Alexander Fleming lecturing in America pointed out that no one could commit suicide with penicillin even if a determined attempt was made! The rates at which antibiotic substances have been found effective in controlling various plant ailments are very low, *e.g.* rates of 10 and 40 p.p.m. may be cited.

In any case, there are two factors likely to dictate lowness of application rate. First, antibiotics (so long as they must be produced by fermentation methods) will tend to be more costly than conventionally produced chemicals. Second, if high rates are needed to achieve control over disease, the remedy may well be impractical through toxic effects upon the plants; for most cases of antibiotic fungicides so far studied, the margin between control and phytotoxicity is very narrow.

On the other hand, it is being realised that some antibiotics, notably streptomycin, are taken up systemically. This may raise the problem of residues *in* rather than *on* foodstuffs, and where the antibiotic substance already has a history of resistance-development in medical use we may well anticipate that ultimate sanction for agricultural spraying use will be most cautiously given. Ideally, antibiotics that are not likely to be used in medicine will be preferable for agricultural development. However, it is only when there is a wide demand for an antibiotic substance that its production costs can be significantly brought down.

Mechanical Handling

Part 1—In the Field

P. H. SOUTHWELL

An increasing tempo in farm operations and a shortage of labour in many areas of the world has brought about the extensive use of mechanical handling techniques for the movement of agricultural materials. Methods and equipment for this purpose in the field are discussed below; a subsequent article deals with installations in farm buildings.

IT is first necessary to define the term 'mechanical handling,' since in the broadest sense this may be applied to many mechanised operations in agricultural crop production. The term is generally taken to mean the movement of bulk materials (but not earthmoving) from one point to another by means of mechanical or electrical power and by the use of mechanical, hydraulic or pneumatic contrivances. It does not normally include distribution (as in seeding, for example), nor the imposition of a particular motion (as in haymaking).

Power

The first essential for materials handling is a supply of power. Power means the *rate* of doing work, that is, the work which is done per unit time, and it follows that the greater the rate at which a material is to be moved (*e.g.* in tons per hour), then the higher the power requirement.

Internal-combustion engines are the usual source of mechanical power in the field, this power being employed via tractors, vehicles and various machines; engines and electric motors are the usual sources of power in buildings. One man can produce only about one-ninth of a horsepower; hence the rate at which material can be moved by unaided manual labour is very low unless large numbers of men are employed.

Purpose

The purpose of any mechanical handling technique is mainly twofold:

1. To reduce labour requirements by increasing the work done per person.
2. To speed up the movement of materials.

In other words, the aim is to reduce the time and labour cost involved in handling materials by the substitution of mechanical power for manual power.

It follows from the first purpose named above that capital expenditure on mechanical handling equipment is not justified unless there is a resultant decrease in labour force or a corresponding increase in farm output with the same labour costs. An exception occurs, however, in situations where mechanical handling methods *must* be employed because an adequate labour force is unobtainable; these methods naturally tend to be most utilised in areas where manual labour is scarce and expensive. A further point is that the incidence of drudgery often has a major psychological significance and its elimination is in many countries a direct influence on the availability of labour.

Speedier movement of materials is particularly important during harvesting operations where adverse weather conditions are a major risk and it can result in a higher-quality product, *i.e.* an increase in farm income. A better farm product can also result from a reduction in the number of times a commodity is roughly handled. There are thus two further, but secondary, purposes of mechanical handling which vary in importance according to circumstances:

3. To eliminate drudgery.
4. To give an improved quality of farm produce.

Principles

There are two main systems of mechanical handling and these may be designated (*a*) continuous-flow and (*b*) intermittent-flow. The first is primarily applicable over short distances and is mainly used in buildings, notably in processing operations. The second applies over relatively long distances and is employed in agricultural field work.

Continuous-flow is the simplest and most efficient method; it may form part of a large system—an example is the use of an elevator in a hay harvesting sequence—but it is dependent upon continuous feeding.

An intermittent-flow system effects the handling of a total quantity of material by splitting up into a number of smaller units; this is achieved by tying into bundles or by filling containers. This subdivision into small units is advantageous for certain types of storage and subsequent usage, as well as from the point of view of manual handling, but with a purely mechanical handling system it is preferable that the material bulk be divided into a small number of the largest possible units. The larger the individual units, then the fewer the operations which will be necessary to move the total quantity, *i.e.* the nearer the approach to a continuous-flow system.

Consider, for example, the movement of lime from the production site to the land

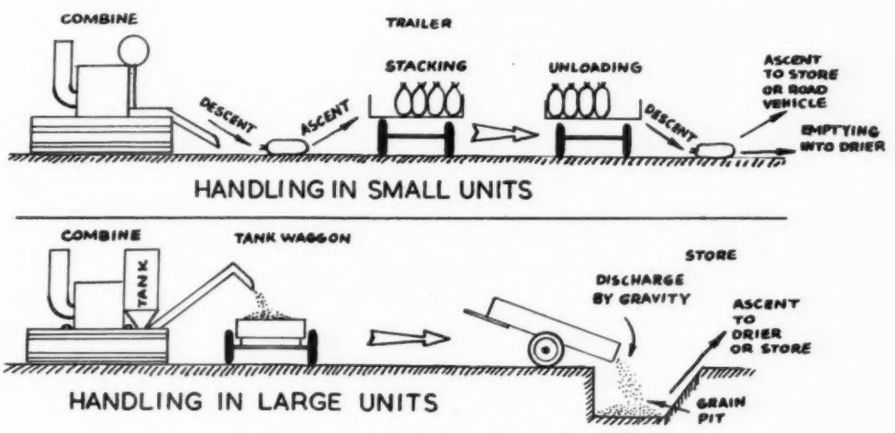


Fig. 1.—Movement from combine to store

Fig. 2.—Sacklifters. (*Left*) **Hydraulic tractor-mounted;** (*right*) **hydraulic trailer-mounted**

on which it is to be applied. If lime is packaged in 1-cwt. bags, each bag has to be: (1) filled and secured, (2) loaded and stacked on a vehicle, (3) transported to the farm, (4) unloaded from the vehicle and possibly stacked for storage, (5) loaded on to the distributing equipment and (6) emptied to feed the distributor. Hence, each unit is handled at least three times, apart from filling and emptying the containers; that is to say, the movement of 1 ton involves the handling of at least 3 tons. On the other hand, if the lime is loaded loose into the large hopper of a vehicle or aircraft, then movement costs are much reduced (particularly if the distributing mechanism is then incorporated with the transporting machine).

Similarly in the case of grain. Sacks from a combine harvester have to be picked up from the ground, stacked on a vehicle, unloaded at the farm buildings and stacked for temporary storage or fed to a drier, etc. If corn was delivered from a combine in 14-lb. sacks, then handling costs would be extremely high owing to the number of units involved. Bulk handling in tanks, however, reduces labour requirements to a minimum, as illustrated in Fig. 1, and also results in less damage and possible loss.

However, the larger the separate units in which movement of a total quantity of material is effected, then the greater the power requirement.

Power availability

It follows from the above that any intermittent-flow system needs to utilise the largest possible size of units compatible with the power which is available on the farm throughout the year. The unit sizes employed for transporting crops during harvesting, for example, need to be the largest which are possible with the sizes of tractor used for other work on the farm. The more efficient the handling system, that is, the shorter the periods of idle time or with partial load, then the more economically each power unit is employed. It is also pertinent that a tractor or vehicle of any particular engine power can achieve a higher rate of material movement (*i.e.* a greater load and/or faster speed) over a hard surface than is possible on soft field conditions. When large quantities have to be moved over fixed routes every year it is therefore sensible to consider laying down prepared road or rail circuits.

In order to evolve an efficient intermittent-flow handling system using large units of material, it is necessary to eliminate all unaided manual handling because of the low power (rate of work) and consequent risk of 'bottle-necks' in the system. Unfortunately, this cannot always be achieved owing to the design of existing field machinery or farm buildings, etc. In practice there are therefore two alternatives, namely: (1) the material is handled loose in large units (*e.g.* trailer-loads) according to power unit size or (2) the material is packaged in units which can be conveniently handled by manual labour and built up into suitable vehicle loads. The first method is the preferred aim, but the second may be enforced by circumstances.

Manual handling

Wherever unaided manual handling is involved in the movement of materials, there is an optimum weight of unit or package. Too heavy a unit results in a reduction in the speed at which individual units can be moved; too light a unit—that is, a weight below that with which maximum speed of motion can be sustained—also gives rise to a reduced rate of handling (tons/hour). Although difficult to achieve, standardisation of the weight units (irrespective of volume) in which agricultural commodities are packaged would be preferable; this also applies particularly from the design point of view with certain mechanical handling equipment.

The greatest manual effort is required in lifting and the simplest mechanical handling devices are those which may be termed 'manual aids.' Sack lifters of the type illustrated in Fig. 2 are an example, but each sack must, nevertheless, be placed on them and moved after discharge by manual effort. The operation of picking up material from the ground should therefore be eliminated whenever possible by transferring produce directly from the harvester on to the transport vehicle.

This is an important point which applies particularly in the case of root crops; potatoes, for example, must be initially handled as small individual 'grains' and picking up from the ground requires considerable manual labour. Similarly in the case of combine harvesters and pick-up balers: the crop is lifted up into the machine and an additional unnecessary handling operation is imposed if the material is then dropped back on to the ground again.

Another example of a manual operation which requires deletion occurs in the use of a hay-sweep carrying to an elevator at the stack; the load is often dropped on to the ground at the foot of the elevator and

then has to be lifted by hand forking. A self-feeder device eliminates this additional work and should also obviate a serious disadvantage which easily occurs, namely that the rate at which material can be moved manually at one place governs the rate at which it may be moved mechanically throughout the rest of the sequence.

Thus, any mechanical handling system needs to be as complete as possible. Men should *operate* machines and wherever manual handling cannot be avoided it is important that men do *not compete* with machines.

Field equipment

Owing to the variety of commodities which are involved in agriculture, there is a wide range of machines for mechanical handling. These are, however, designed to move materials in either the vertical or horizontal plane; field machines are therefore grouped below in accordance with the movement which is effected.

Furthermore, an important asset of any device for mechanical handling in the field is flexibility as to type of load. For example, a portable elevator which can be adapted to raise loose hay, sacks, bales, sugar beet, potatoes or manure to various heights is far more valuable on a farm than one which is confined to a single type of load.

A further necessity in the case of field machines is mobility, or at least portability; great mobility together with the ability to deal with a wide variety of loads is obtained by the use of tractor-mounted equipment. This also gives flexibility in the type of movement which can be effected and warrants special mention.

Tractor-mounted equipment

Cable-operated hoists and shovels have been in use on tractors for some considerable time and are controlled by a winch driven from the tractor power take-off shaft. The marked developments of recent years have, however, been due to the introduction of hydraulic systems on tractors. These hydraulic systems were designed for the operation of implement lift arms at the rear of the tractor and are primarily weight-lifting systems, the lift being achieved by pressure of oil on a piston which operates the arms to which the implement (weight) is attached.

Such hydraulically-operated arms can obviously be employed to lift other weights as well as implements, and special attachments have been made available to permit this; common examples are scoops for earth or stones and lift boxes for sacks and churns. There is, however, the added advantage that once a load has been raised, it can be carried over the ground by the tractor and subsequently deposited at another place. Hence the alternative names 'lift box' or 'transport box' and the increasing use of this type of attachment for light tasks. Rear-mounted tractor buck-rakes are also popular for the same reason: once the sweep has been filled by rearward movement of the tractor it can be raised and carried to the stack at top speed.

Fig. 3.—Rear transport box

The implement lift arms only permit a relatively small height of lift, however. A further development has therefore been to make use of the hydraulic pressure which is available on the tractor in order to operate a special lifting device. This usually consists of two long, forward-projecting lift arms which are pivoted at each side of the tractor and which can be moved up or down by means of hydraulic cylinders.

This type of installation is usually known as a tractor 'front-end loader' and has revolutionised many farm handling operations, various equipment being available for attachment at the end of the lift arms. A shovel, fork or sweep, for example, is filled by forward motion of the tractor with the arms in the lowered position; the load is raised by hydraulic pressure acting on the pistons in the cylinders and

Fig. 4.—Tractor with rear-mounted sweep

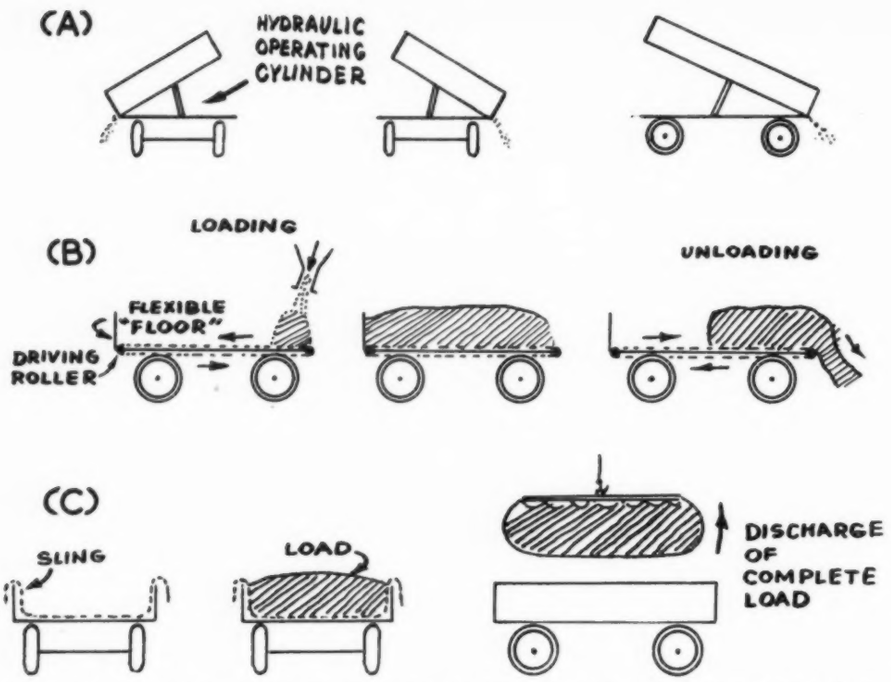


Fig. 5.—(*a*) **Three-way tipping trailer for movement to ground level or below;** (*b*) **moving-floor vehicles for movement to floor or ground level and for distribution; and** (*c*) **slings in trailers for upward movement into buildings**

it can then be transported by moving the tractor. Platforms can also be attached for general transportation and lifting purposes, whilst grabs have been designed for lifting sacks and silage, for instance. The maximum height of lift varies with the design of individual loaders, but some have provision for extension jibs to facilitate unloading on to stacks and so forth.

The versatility of tractors equipped with front and rear lifts is such that they are becoming established as the general-purpose tools for mechanical handling on farms; this is a position comparable to that of fork-lift trucks in many manufacturing industries.

Lifting devices

The arms of a tractor front-end loader raise a weight by motion along the arc of a circle, as a turning wheel can be made to do. There are, however, two other mechanical ways of effecting movement in the vertical plane, namely (*a*) direct lift and (*b*) movement up an incline.

A direct vertical lift is achieved by a winch-operated cable on a crane or derrick. A jib crane, by means of which a load can also be swung through a horizontal arc, is probably the most popular type for field work and is still used to lift complete loads of loose hay on to stacks, for example.

The most common equipment effecting movement up an inclined plane is the elevator. This consists essentially of an engine-driven endless band which is of such a length and is so inclined as to give the required height of lift. Chain elevators usually have a specialised application, such as root-crop or manure loading, and an open-chain type is used on some bale collection machines. Belt elevators are commonly used for loose and light materials but general-purpose elevators which have detachable transverse tines and are capable of dealing with hay, straw, sacks and bales are the more valuable machines. Some general-purpose elevators with movable sides are also able to handle root crops and manure.

Another method of raising loose material up an inclined plane is by means of reciprocating rakes. The rakes consist of long bars fitted with tines and are given a reciprocating motion by means of engine- or wheel-driven cranks; this principle is used in conjunction with a pick-up device on many hay and green-crop loaders.

Devices of this type play an important part in eliminating manual labour from materials handling systems in farm field work. Pick-up balers may also be classed as mechanical handling equipment, but the bales should be fed on to a sledge or trailer. A belt-type hay loader which does not have a pick-up cylinder can be used for collecting sheaves, and tractor-mounted sweeps can pick up whole stooks. Green-crop loaders need to be more strongly constructed than hay loaders, but machines capable of either task reduce the total capital outlay.

A further means of carrying chopped or light materials either vertically or up an incline is the pneumatic method which is employed in some forage harvesters and combine harvesters. This relies upon a high velocity of air to carry material such as chopped grass through ducting and into a trailer behind the machine; the air velocity is created by a fan and the material becomes, in effect, airborne.

Horizontal movement

Movement over short distances in the horizontal plane can be effected by augers and conveyors. Augers and oscillating conveyors can only deal with loose materials, but belt and chain conveyors are more versatile; many instances of the use of these devices are found in the construction of field machinery.

Short hauls of heavy loads over the ground can be carried out by means of a winch; this method has been used to haul manure out of a yard and up to an elevator. The most common application at the present day is in timber haulage, but mobile tractor-mounted winches have many uses.

Some form of wheeled carrier is, however, necessary for movements over long distances. As already mentioned, a tractor can be used as the vehicle as well as the power unit for small loads, but for large quantities the most common method of farm haulage is a tractor and trailer combination. Tipping trailers, particularly those which can be tipped hydraulically in more than one direction, have considerable value when handling grain and root crops. The use of a sling, which is placed in the trailer before loading and is then used to discharge the vehicle in one single lift, is a method of mechanical handling which deserves exploitation but is dependent on the availability of a suitable crane or hoist. Similarly, the value of moving-floor vehicles has yet to be fully explored.

Road vehicles can be very useful for field transportation when conditions are suitable, and other machines which have the power supply and body capacity in one unit are self-propelled carts and 'dumpers.' The application of these machines is, however, limited by non-suitability for fast road haulage and the inability to use the power unit for other farm work.

Conclusion

Success in mechanical handling for farm field work depends upon the integration of various equipment to give maximum efficiency in accordance with the principles outlined above. Naturally, considerable diversity of detailed arrangements is caused

(*continued on page* 231)

Investigations on the Control of the Olive Fly in Italy and Greece

C. LOGOTHETIS

Entomologist, Agricultural Division, FAO

For many years the olive fly Dacus Oleae *has been a source of loss and difficulty to olive growers in the Mediterrean region. The matter was referred to in an editorial comment in* WORLD CROPS *in June last; since then FAO has convened a conference in Florence to discuss the problem and has initiated experimental work for the control of the pest in Italy and Greece of which an account is given in the article below for which we are indebted to the organisation.*

THE conference on the olive fly, held in Florence, Italy, in March 1953 invited FAO to assume the leadership in in co-ordinating the new investigations to be undertaken by countries of the Mediterranean area against this insect. In accepting this responsibility the Organisation proposed the creation of a working party, to be composed of specialists in this field, and appointed the writer, staff entomologist, to act as the FAO representative and technical secretary of that party.

In conformity with the resolutions adopted at Florence, a number of the participating countries agreed that during the 1953 season they would conduct a series of experiments for the evaluation of the standard method of control, the Berlese method with its recent modifications, and for the development of even more efficient methods. In response to requests from the Governments of Italy and Greece the writer visited the majority of the experimental areas of these two countries in order to obtain first-hand information and make personal observations on the results of these experiments.

Berlese method with various modifications

This method consists of the partial wetting of the tops of the olive trees with a white arsenic solution to which molasses or other sweet substances are added to make it attractive to the adults of the olive fly. The solution is applied in a jet stream by a knapsack sprayer. The Italian workers have concentrated their efforts on this method and have proved its effectiveness.

In the Grosseto-San Vincenzo area the treated areas were found to be over 95% free from any infestation, while the neighbouring untreated groves showed an infestation of 60 to 100%.

In Sicily the picture was slightly different. Here, too, the difference between treated and untreated areas was obvious but not as spectacular as in the San Vincenzo area. Whereas the untreated zones had an infestation of 60 to 100%, the percentage of infested fruit in the treated zones reached from 30 to 60% also. The reason for the lesser efficiency of this method in Sicily has been explained as follows: the treatments were discontinued after the rains of early October and the infestation had occurred since that date. This is very probable and its significance will be discussed subsequently.

The olive groves in Greece where field tests were made

The Berlese method was properly applied in Greece only in the Pelion area. In reality the work here was not done on an experimental basis but rather as an application programme financed completely by the producers themselves. But since some communities requested the application of this method while others refused it, the conditions were most appropriate for observations. In the untreated communities the infestation varied from 20% to over 80%, while in the treated communities the infestation varied from 2 to 3% to as high as 40%. It was explained that the communities which had less efficient protection were those where there were greater difficulties in organising control units and repeating the applications on time. With respect to the varied degree of protection rendered by the Berlese method it is well to remember that the degree of normal infestation varies greatly with the year, with the location of an orchard and even within the same orchard, making the observation of control efficiency rather difficult. This is a factor of great importance.

The use of Parathion

Parathion, malathon, dieldrin and DDT have been among the recent insecticides investigated, but since parathion is the

only one which has given really promising results, only this material is discussed here. Excellent results have been obtained with parathion both in Italy and in Greece.

The principle involved with parathion treatments is the ' cover spray ' or complete wetting of the entire tree. In other words, this treatment is the same as that commonly used against any fruit orchard insects. Parathion has been used in a limited area in Italy during the past two or three years. The Italian workers, however, consider it rather expensive when compared with the Berlese method and it is suggested only as a supplementary measure in emergencies during extremely heavy infestations or for use by those who feel they can afford the expense.

After several years of preliminary experiments with parathion, Greece this year concentrated her efforts on developing a ' method ' of controlling the olive fly with phosphoric ester compounds. Experiments with parathion were the most extensive, using dust and liquid forms in from very high to very low concentrations, and with one to five applications. Sampling for infestation and for residue analysis was initiated from within a few hours after application up to the harvesting period. The control tests were carried out in various parts of the country varying from continuous areas to completely isolated islands.

All tests proved the effectiveness of parathion beyond any doubt. In powder form it will kill the adult flies in the treated trees, but it loses its effectiveness within two to three days. In liquid form, in addition to killing the adult flies in the orchard for a few days, it is absorbed by the fruit and protects it for a long time. It is absorbed sooner and remains effective in the fruit for longer periods in the form of emulsion rather than in aqueous suspension. It has been demonstrated that over 99% clean fruit may be obtained with only one application of 0.6 parts of the active ingredient to a thousand parts of water. This treatment continued killing newly hatched larvae for over 65 days after application with no apparent loss of effectiveness. Separate chemical analyses for residues in fruit and oil in this experiment indicated a parathion content in the oil of up to only 1.6 parts per million. This is very encouraging in view of the fact that the residue tolerance of phosphoric esters has been established by the Food and Drug Administration of the U.S.A. as 2 parts per million. These tolerance figures are, however, subject to revision, as the problem is comparatively new.

It should be pointed out here that parathion is absorbed and held for an undetermined length of time only by the oil in the fruit. The long duration of the effectiveness mentioned above refers to applications made in about the middle of September, a time when the fruit starts accumulating oil. In the absence of oil in the fruit the parathion undergoes complete chemical decomposition in about 20 days.

Spraying team using Parathion

This method introduces a new principle of olive fly control. Whereas the Berlese method aims at ' preventive control,' *i.e.* killing the adult fly before it can oviposit, this method aims at ' protective control,' *i.e.* killing the young larvae in the fruit. In addition to the fact that a high percentage of the eggs in the treated trees will fail to hatch, the young larvae will die at most within four to five days after hatching and before they can cause any blemish on the fruit. Whereas the Berlese method aims at reaching the adults wherever they may be (wild olive trees or other food trees), this method can be used to protect only the trees which bear an economic crop. This aspect is of great importance, as will be seen in further discussion.

This 'Junior' spray machine was located in such a position that it could spray a 200-tree plot without moving the machine

Comparison of the two methods

Until two or three years ago the only available method for controlling the olive fly was the partial wetting of the olive trees with poisoned (arsenic) sweet substances in water (Berlese method). Much has been written on the effectiveness of this method, but it has never been applied on a large scale throughout the Mediterranean area. The only exception has been Greece, where the method has been generally applied since the late twenties. The argument against the method has been that it cannot provide the desired protection when it is most needed, that is during heavy or late fall infestations. This is particularly true in the case of table olives, or late-maturing and late-harvested fruit for either table or oil varieties. The following is a fair comparison of the Berlese method with that using parathion.

Berlese method

Advantages

1. When applied correctly and timed

Dusting an olive tree with parathion

properly it gives, under certain conditions, excellent protection.

2. When the results obtained are satisfactory it is very economical.

3. The method of application is simple and can be done with the conventional knapsack sprayers.

4. It can be applied to trees of almost all sizes.

Disadvantages

1. It must be applied on a large number of trees in a given area or it is of very little value.

2. It requires at least six applications per season and very frequently even more because it must be repeated after each rainfall.

3. The treatments have to be very carefully timed. The effectiveness of each treatment lasts only for two or three days and, if the fruit is left unprotected even for only two or three days, at the appearance of each generation it may be infested 100%. This is especially important in the fall generation or in climates where the generations are continuous or overlapping, in which cases the fruit must be protected continuously.

4. It is effective only where the fruit ripens early and is harvested as soon as it ripens, or harvested while it is partly green and soon after the commencement of the autumn rains. This is true in the northern climates of the olive belt and where usually the fruit is small and destined for oil. It is not effective after the commencement of the autumn rains in areas where both table and oil olives are left on the trees until the end of December and in some cases until the end of the following March. Such conditions prevail in many parts of Greece.

5. Since control operations have to be applied on a large scale and very carefully timed it follows that the work must be done by hired and well-supervised personnel. The grower himself does not actively participate in the protection of his own crop. It is only natural to assume that hired labour may not always be trusted to perform correctly the difficult task of spraying olive trees for long periods.

The use of Parathion

Advantages

1. Although no definite method has been formulated or proposed yet, it appears that only one application, or perhaps two at most, will give complete protection on all varieties—for table use or for olive oil.

2. It is not necessary to repeat the treatment after rain because it has been proved that the active ingredient is absorbed in the fruit within 30 to 60 minutes after application. Once in the fruit the parathion is 'tied up' by the oil and atmospheric conditions cannot affect it.

3. It does not require organised operations on a large scale. An individual tree or even half a tree may be completely protected. This means that a progressive farmer need not depend, for the safety of his crop, upon the goodwill of a farmer who is situated some miles away.

4. One very important factor in favour of this method is the fact that the farmer does not have to wait each time for inspections and advice from government authorities nor does he have to depend upon casual labour to do the work on his property. The moment he observes a certain degree of oviposition in his orchard he can start spraying operations. If infestation is delayed or is extremely light he may delay treatment or cancel it altogether.

5. There is no need to spray all the trees. In 'off' years he does not have to spray the trees which have so little fruit that it would be uneconomical to harvest it. There are some varieties which are resistant to attack even under very heavy infestation; these need not be treated. The writer has seen extensive areas of trees with less than ½ kg. of fruit on each which were not worth saving but which received eight or nine applications of the Berlese method in order to protect the relatively few trees in the area which had a full crop. These few productive trees could easily be protected by parathion application.

6. Whereas the poisoned sweet substances of the Berlese method are effective only against the adults of the olive fly and nothing can be done to save the fruit once oviposition has taken place, parathion, on the other hand, in addition to being effective against the adults, larvae and, to some extent, the eggs, will control other olive tree pests such as scale insects and especially the all too important, in some areas (Greece), olive kernel borer, *Prays oleolus*.

7. Although parasites would be less important if the parathion method were developed and adopted, nevertheless it can be stated here that parathion, usually applied towards the end of September, is completely harmless to parasites of the olive fly because their activity ceases by the end of September.

Disadvantages

1. In order to give the spectacular results mentioned, this method presupposes that the trees are thoroughly sprayed. This means that each individual fruit must receive at least a few drops of the spray liquid. This is easy for such olive groves as are found in Tuscany, Sicily and Crete where the trees are relatively short, but is difficult in areas such as Pelion and Corfu where the trees attain great heights. This condition would necessitate the introduction of power-driven machinery, but because of the terrain ground power equipment cannot be used everywhere. The possibility of using aircraft should not, of course, be overlooked.

2. Complete wetting of trees means use of considerable amounts of water. Since the olive tree is usually grown in dry areas and on drier hillsides, and since spraying is done during the dry summer months, water scarcity becomes quite an important factor. The introduction of low-volume spray equipment should, however, greatly reduce the water requirements.

3. Although parathion is not a stronger poison than white arsenic, it is more dan-

gerous because it should be applied in a fine spray and might more easily fall unnoticed on to the operator in very fine droplets. Great precaution is therefore necessary in its use. Parathion is however being used elsewhere against other pests and it has not proved more dangerous than other poisons when normal and simple precautions are taken.

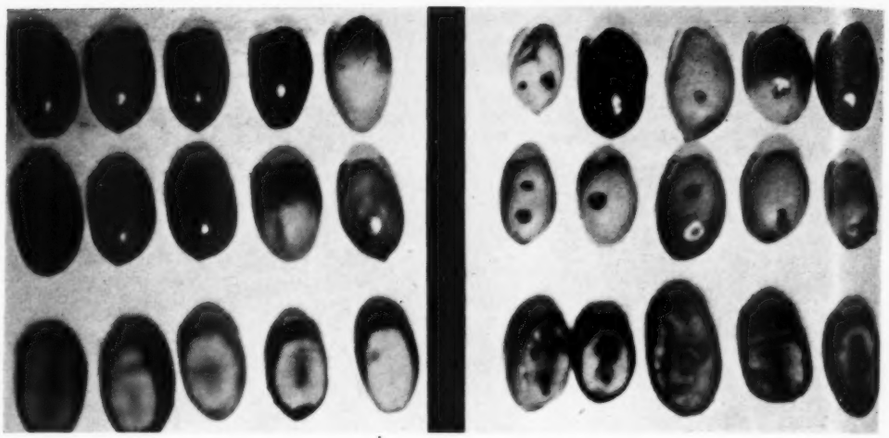
4. The parathion residue in fruit and oil and the effects of continuous consumption of these products from treated trees is a problem yet to be solved. It is true that a method of analysis has been developed and the results thus far indicate that the parathion residue recovered is below the accepted tolerance level, but the use of this insecticide cannot be recommended until the method of analysis has been perfected and the results have been replicated by other investigators and the effect on animals of even these small quantities in oil have been thoroughly investigated.

Discussion

The control of the olive fly may be divided into two categories.

The first prevails in areas where protection is required only until the middle of October when the fruit is already black and harvested, or when it is harvested partly green because it will give better-quality oil, or because otherwise the crop would be a complete loss. Tuscany and Sicily may be cited as examples of this type. In Tuscany, by the end of October the fruit is almost black and will render the maximum quantity of oil although it may have recent infestation. In Sicily, if the crop is not harvested after the end of October the infestation will increase rapidly and cause considerable dropping of the fruit, considerable loss of oil and oil with a higher percentage of acid ; accordingly farmers prefer to reap early even though they may lose 10 to 15% of oil production because of the incomplete maturity of the fruit. Where growers are able to harvest their crop in a short time and have sufficient presses for extracting the oil and where even 100% of recent infestation will do no harm the Berlese method with five to nine applications appears satisfactory. There is no doubt, however, that if another method, more effective and not much more expensive, were to be found the farmers would adopt it. The possible slightly higher expense would be more than balanced by the higher yields which would result from the complete maturation of the fruit.

The second control category prevails in areas which grow the large table olive varieties which must be left on the trees until completely ripe. In most areas where these are grown this means that the fruit is left on the trees to the end of January. It also prevails in the case of oil olives which mature from the end of October to the end of January, the harvest of which continues until the following spring. Growers allow the fruit to drop to the ground rather than pick it by hand, or force it to drop by hitting the branches. This late harvesting is often practised in many islands of Greece. Considering that the most serious infestation—and consequently the greater loss—takes place late in the fall, and that in the warmer climates the adult olive fly is found in orchards all the year round, it is easy to realise that the crop in these areas needs protection until the very end.



(*Left*) **Sound olives.** (*Right*) **Fruits showing typical dacus fly damage. Larvae may be seen on some fruits**

Division of opinion

These examples explain why for many years opinion has been divided with regard to the merits of the Berlese method. A separate solution must be found for each case. It is interesting to note, however, that although methods have been improved or changed against many known pests following the recent spectacular progress in the field of new insecticides, very little progress has been made against the most important pest of this region, the olive fly. The problem has now been well differentiated and appropriate and more efficient methods are being sought for each case.

The introduction of the use of parathion in the control of this insect and the experimental trials thus far undertaken do not yet constitute a ' method.' There still remains the necessity to establish the minimum effective dose, the number and timing of applications, the appropriate type of application equipment, the applicability and the associated economic factors. The most important aspect which needs further investigation is the residue problem. This is important not only with respect to the danger to workers applying parathion and to those who make use of the oil but also with respect to the effect it may have on the acceptance of such oil in the international market.

Economic aspects

With regard to the economic factor, there is every reason to encourage a very optimistic outlook if we consider that:

1. The price of parathion would be reduced if it were imported in relatively large quantities.

2. Even at present prices one application with only 0.6 parts of parathion to a thousand parts of water is reasonably inexpensive and compares favourably with nine to ten applications with the Berlese method.

3. The spraying of only those trees that bear fruit will greatly reduce the expense per tree when we consider that all the trees have to be treated repeatedly by the other method.

4. If the work is done by the farmer himself there is a considerable reduction in administrative expenses. The social and psychological factors are also depressing when a grower with very little income has to pay and depend upon others to do such vital work on his own property.

5. Expenditure would be reduced further by the resulting increase in income from the crop. If parathion can assure the crop until maturity the farmer may then thin off the crop by collecting part of the green olives for marketing.

Conclusions and recommendations

1. Experimental and demonstrational evidence have proved this year that the Berlese method, with or without modifications, when properly applied, can provide economical control of the olive fly until the

commencement of the autumn rains and in regions where the crop is harvested rather early. The method, however, is inadequate for table olives or oil olives which are left on the trees in order that they may become completely ripe beyond the end of October.

2. Co-operative experiments in Greece and Italy have also shown that phosphoric ester compounds, especially parathion, used even in concentrations of 0.6 per thousand and in only one aqueous application, are very effective against the larvae in the fruit where the active ingredient is absorbed and retained in the oil. This is indeed very encouraging progress and the method should certainly provide the degree of protection needed for late-harvest varieties and, if the final results prove completely convincing, it might even replace entirely the Berlese method.

3. The use of parathion is still in the experimental stage and cannot yet be officially proposed and recommended as a 'method.' The results obtained thus far are certainly encouraging, but the utmost care must be exercised with respect to toxicity and toxic residue problems.

4. If continued efforts prove the value of the method and confirm the preliminary results, it can be stated that this method will be a most satisfactory solution for those who wish to protect their crops.

5. Even though the method may prove satisfactory from all points of view, research efforts should continue not only for the improvement of this method but because with the continuous appearance on the market of newer and more efficient insecticides an even more satisfactory method may be developed.

6. The interested countries have already made a valuable effort and have undertaken co-operative and co-ordinated investigations in this field. FAO has already expressed its interest in the problem and convened a special meeting to co-ordinate activities of the already formed working party. It is suggested that the Organisation continues to render its full moral support and continues its function as co-ordinator.

7. Since the results of both methods have been rather spectacular and since a great deal of data have been accumulated, it is strongly recommended that another meeting be convened early next spring.

FAO Visitors to Latin America

In preparation for the Third FAO Regional Meeting on Food and Agricultural Programmes and Outlook in Latin America, to be held next September in Buenos Aires, Argentina, a group of FAO staff members visited from mid-March to the end of April several Latin-American countries, to obtain first hand information on government agricultural policies and to have a preliminary exchange of views with government officials regarding the regional meeting.

Headed by G. Casseres, FAO's regional representative for Latin America, the team first visited Chile, arriving in Santiago on March 13; it was then to proceed to Argentina, Uruguay, Brazil, Colombia and finally Mexico. The other members of the FAO group were A. Saco, chief of the Latin-American section of the Economics Division; A. Vergara, Latin-American regional representative of FAO's Nutrition Division; and G. Bildesheim, Agricultural Division specialist on Latin-American programmes.

The importance of the regional meeting on Food and Agricultural Programmes and Outlook was strongly emphasised during the seventh session of the FAO Conference held in November-December 1953, as well as the need for a more selective expansion of agricultural production, combined with active methods of stimulating consumption in the immediate future, since some significant surpluses of food and other agricultural products began to develop in 1953.

So far—the conference pointed out—these surpluses have been most serious in the dollar area, where agricultural expansion has hitherto been greatest, but they are now beginning to appear in other regions as well. On the other hand, food consumption levels over large areas of the world are still inadequate and production is insufficient to meet the increasing needs of a fast growing population, the growth rate of which in Latin America is among the highest in the world.

Thus, the Latin-American regional meeting will include consultations on the regional level for the co-ordination of national policies along the lines of the selective approach of production and consumption; and the visit of FAO's staff members was not only useful to discuss with governments their agricultural production and consumption policies in the light of selective expansion, but also to consider the proposals for the agenda of the meeting and the steps to be taken to establish adequate machinery for the implementation of agricultural programmes.

Other matters which were to be dealt with by the FAO team include policies regarding price and other economic incentives to farmers; problems related to both public and private financing of the various agricultural projects; the main technical difficulties that have to be overcome in implementing the programme and the expected short- and long-term trends in exports and imports of agricultural products.

It was expected that the different Latin-American governments would organise formal meetings and round-table discussions with the FAO visiting group in dealing with all these subjects. They were also to discuss the necessary changes in consumption and nutritional targets in view of possible changes in production goals and the extent to which consumption of protective foods may be expanded, for example, by the increased consumption of fish.

Finally, also to be discussed was government action directed to reduce retail prices of agricultural products through improvement in marketing facilities and in lowering of production costs without adversely affecting farm and labour incomes.

Mechanical Handling

(*continued from page* 226)

by local circumstances and the different crops involved, but the general requirements may be summarised as follows:

1. Adequate, but not excessive, power supply.
2. Reliable equipment with maximum flexibility.
3. Elimination of all potential 'bottlenecks,' particularly those due to manual handling.
4. Careful organisation to give a continuously smooth-running system under the conditions obtaining.

The most striking development of recent years has been the introduction of tractor-mounted, hydraulically-operated equipment; a tractor with both front and rear lift arms can be used to lift and carry light loads as well as to fill and tow heavy trailer loads. Thus has flexible mechanical handling equipment been superimposed on the basic farm machine and placed within the control of a single operator for a wide variety of tasks.

Photos: Fig. 2 (left) E. O. Culverwell Ltd., (right) Telehoist Ltd., Fig. 3 Massey-Harris-Ferguson Ltd., Fig. 4 Ford Motor Co. Ltd.

The Development of New Zealand's Pumice Lands

JOHN GRINDROD, B.A.(Com.)

In the north island of New Zealand there exist extensive tracts of land overlain by deposits of volcanic ash and rubble which have for long been considered to be unusable. Their development has recently been undertaken by the New Zealand Government.

IN the heart of the North Island one of the most extensive land development projects attempted in New Zealand is turning waste and unproductive stretches of country into fertile and economic farm units.

For many years these wide tracts of pumice scrubland in the Rotorua-Taupo area were considered unsuitable for any type of farming use and, apart from a few small-scale attempts, no serious effort was made to improve the land. Formed largely by showers of volcanic ash, the top soil of this area had for long been poisoned by the scourge of bush sickness.

Cobalt deficiency

Although no large-scale attempts had been made to convert these Crown lands into useful agricultural land, scientists had spent many years in trying to find out how the soil could be treated chemically to make it fertile. At last, early in the 1930s, it was discovered that the trouble was due to cobalt deficiency and that application of cobalt-sulphate was an effective cure.

Armed with this knowledge the New Zealand Land and Survey Department has gone to work and, particularly since the war, has vigorously pursued a broad policy of land development laid down by successive governments. Thousands of acres, previously covered with scrub and manuka, have been cleared, ploughed and grassed.

Development schemes

Development schemes under the control of the Rotorua office of the Land and Survey Department cover a total area of 300,000 acres earmarked for sub-division into small farms. The development of a further 100,000 acres has been deferred for the time being. So far, 90,000 acres have been developed and split up into 450 farms carrying dairy herds and sheep. These have been handed over to settlers.

Bounded by Tauranga in the north-west, Opotiki in the north-east, Putaruru in the west and Tokaanu to the south, the Rotorua development district contains many types and conditions of pumice and presents a complex of soil science problems. The biggest single development scheme is in the Mihi block project, some 30 miles from Rotorua and bordering on the main Rotorua-Taupo highway. The department hopes to convert 41,000 acres of this flat or undulating pumice scrub into valuable farming land. The full sub-division of the land has not yet been finally approved, but to date 62 farms, totalling 10,782 acres, have been settled. The remaining area is expected to provide 95 dairy and 25 sheep farms. Of these, 18 dairy farms and one sheep farm will be settled by 1954. Eleven thousand acres are already in grass preparatory to their being split up. Begun in 1948, development is expected to be completed by 1965. Small difficult areas may take longer, however.

Preference in the allocation of farms is given to ex-service men, but the Government has already announced that, at some future date, a certain number will be available by ballot among applicants who cannot claim war-time service.

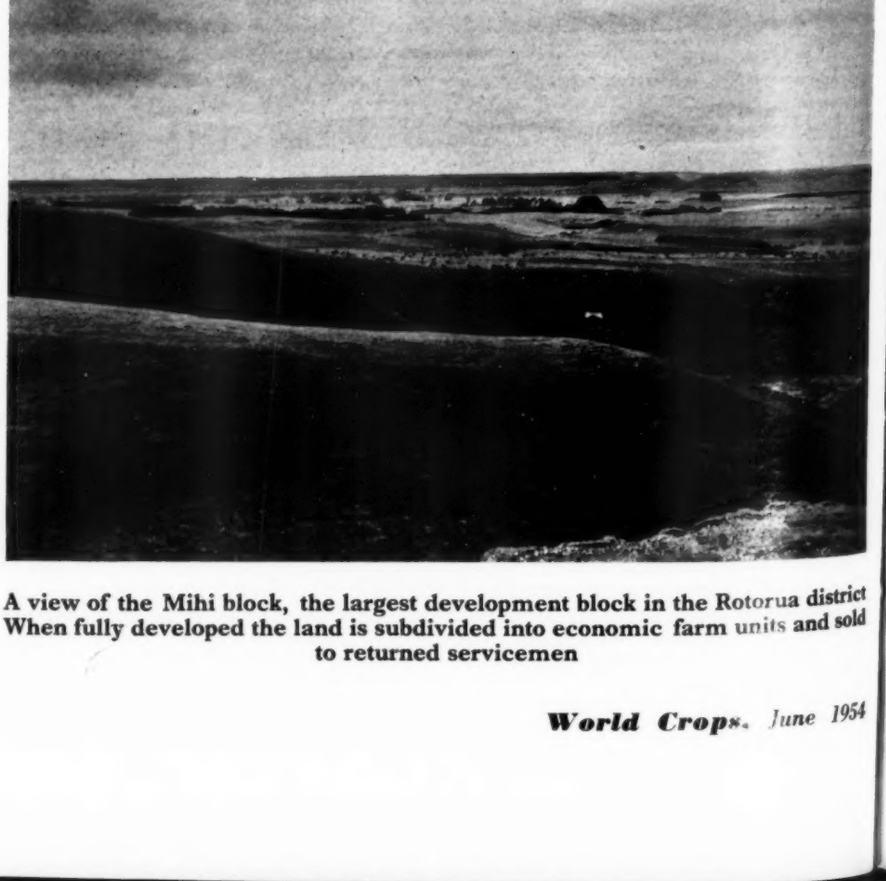
Methods of treatment

Treatment of this pumice land calls for the use of modern equipment and work is undertaken by private contractors. First the manuka is flattened by tractor-drawn rollers, then burnt off. After clearing, the land is ploughed with semi-swamp ploughs, by means of which a bigger furrow is obtained than with normal ploughing and the manuka stalks, left after the burn-off, can be buried. Where the terrain is too steep for ploughing, giant discs are used.

Following this mechanical preparation, the soil is fertilised and grass is sown. For these processes aircraft are used for the rough slopes and hill-tops. In the Mihi block alone, 4,680 acres were sown to grass during the year ended June 30, 1953. It is planned to have a further 3,900 acres under grass by June 1954.

Stocking

The first growth of pasture has to be consolidated and this is achieved by heavily



A view of the Mihi block, the largest development block in the Rotorua district When fully developed the land is subdivided into economic farm units and sold to returned servicemen

stocking for two years with dry stock—that is to say stock not in milk. During this time the pasture is carefully watched by the block supervisor until such time as it has become satisfactorily established. The stock normally used for consolidating purposes are two- and three-year-old steers and two- to four-tooth wethers. They hold the pasture during the flush season and, at the same time, tread the soil down until a firm base is established. The stock is eventually marketed as prime three-and-a-half- to four-year-old bullocks and fat wethers. The land is then ready to be handed over to the settlers. The units are allocated by ballot and finance for the successful applicants is arranged through the Rehabilitation Board.

Size of farms

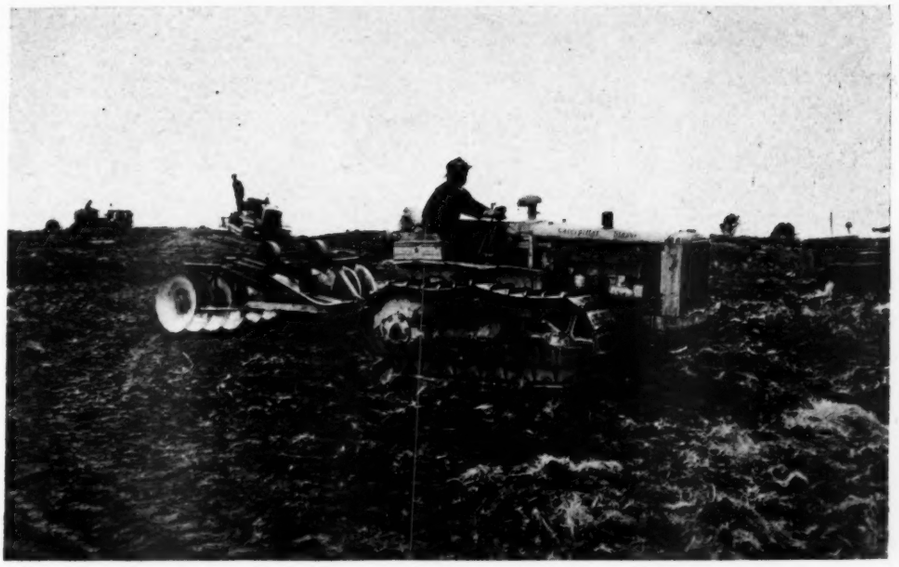
When handed over to settlers the sheep farms, varying in size from 300 to 500 acres, usually carry up to 750 breeding ewes, as well as supporting cattle. The potential carrying capacity of such a farm is 1,000 ewes and supporting cattle. The average size dairy farm is 150 acres and such a farm carries, in the first place, from 65 to 70 cows.

Houses built of permanent materials, but usually prefabricated at a central depot and transported complete to each home site, are provided on each unit. They are built to standard specifications and are so planned that they can be added to as required.

Some difficulties

Much fine work has been done by the Land Development Department in Rotorua and more is being tackled in the future, but the project is not without many serious problems and complications. Although some of the pumice land has proved to be excellent farm land, as for instance at Ngakuru and Ngongataha, two of the earliest settled areas on some of the best land, other areas are not proving so easy to handle. Indeed, the potential farming quality of the land varies greatly and is quite different from one region to another.

This is due to a number of causes, including variation in the character of different volcanic eruptions and the action of the weather. The most important eruption took place a few thousand years ago from vents around Lake Taupo when 5 cu. miles of pumice were blasted into the skies to be showered down on to the earth as dust over a wide area. On the edge of the area affected, near Rotorua, the pumice settled as fine dust, but near the centre of the eruption, at Wairakei, it fell as coarse rubble up to 80 ft. deep. Between the two the kinds of pumice deposits were many and varied. The fine-particle pumice makes rich volcanic soil capable of yielding high butter-fat returns to small farmers; the coarse dry rubble is suitable only for large dry-stock holdings. The coarser the pumice, the faster it loses moisture, the faster the grass yellows and the faster the earth dries to dust and is blown away.



Giant discs are used to break up the land and bring it into production. Teams of tractors are used for the work

Again, on the high lands the pumice has lain undisturbed, with fine, moisture-holding particles at the surface. On the lower lands, rivers and rain water have churned it up into a porous mixture. During this process the finer particles have been sifted down below the reach of the roots. This ' water-sorted ' sub-soil is the poorer farming land and it presents problems not found in those areas where the pumice lies undisturbed. Before this indifferent type of pumice land can be made really to flourish, much research will still have to be undertaken to discover the best way of improving it and of utilising it when improved—whether for small farms, large holdings or forestry.

Land usage

In the past the latter consideration has not always been taken into account and some of the best agricultural land has been planted with trees. Today the Land Development Branch has an understanding with the Forestry Service about the suitability of new lands for different purposes. Land utilisation officers of the Lands Department have catalogued the, as yet, unimproved pumice country either as suitable for immediate development or unsuitable. The decision as to which blocks are to be worked is made by the Land Settlement Board in Wellington, on which sits the heads of many departments and two private farmers. Recommendations are made to this board by the Lands Department, based upon survey grading and knowledge of the country. Once the decision has been made which lands shall be developed, the Lands Department is given a fairly free hand to get on with the job, and is concerned with the practical business of ploughing and grassing thousands of acres with as much mechanical aid, both from land machines and airborne machines, as possible. For aerial top-dressing a special airstrip has been built in the hills above the Rotorua-Taupo road at Mihi. For access purposes the Ministry of Works has contractors and its own gangs laying 70 miles of roads each year.

Need for more research

While it is recognised that there is much to be said for having this great development scheme under single management, the procedure adopted has come in for some criticism from scientists and others, who believe that much could be gained from their greater co-operation. They feel that the Department of Agriculture and the Department of Scientific and Industrial Research could play a valuable part in the selection of lands for development and their division into units. They claim that insufficient money is being spent on research before land is selected for development and before settlers move into it, and that, without interfering with the business of development, the scientists could assist the scheme by making farming trials. They would like to see established an experimental farm at Wairakei, where they have picked out a 500-acre site which covers soils of many different types.

Beef cattle being driven along the Rotorua-Tanpo road. Each year the Lands and Survey Department brings thousands of head of cattle for grazing on newly developed land. Both sheep and cattle are used for consolidation purposes

A concrete example of the type of land which the scientists say should be the subject of more research lies in the Wairakei and Oruanui region, where some 9,000 acres have been grassed but where almost no attempt has been made to establish a farm. It is intended for sheep farming, but, until recently, it is claimed, almost no scientific work had been carried out there. Recently the Soil Bureau has been testing the water-holding capacity of the land to find out whether it is good enough to keep pasture alive in dry weather. The scientists claim that the land here is of doubtful value and that such tests should have been made before a plough was put into it. They also say that, both at Oruanui and elsewhere, a permanent pasture is not established before the settlers arrive.

On the other hand, the Lands Department claims that Oruanui is sound country and should be as good as other districts when it has been grazed long enough. It claims that, by and large, any land in New Zealand under 2,500 ft. with a 30-in. rainfall and easy contours should be farmed in time. It contends that the programme cannot wait on scientific experiments, which may yield no conclusive results in a short time, and that the opportunity for research lies in the 100,000 acres or so of deferred pumice lands south of Taupo.

Conclusion

In spite of differences of opinion the work goes on and each year will see the release of many entirely new farms to produce meat, dairy produce and wool for the world overseas. The cost of the new land, grassed, ring-fenced and watered, works out at £20 to £30 an acre, but this cost is more than offset by the profits from the scheme's own farming on land not yet ready for sub-division.

One of the greatest lessons learned from the undertaking has been that large-scale development with mechanical equipment, making liberal use of the contract system and of the bulk buying of materials, can be applied successfully to the pumice lands of New Zealand.

New Varieties of Potatoes Resistant to Late Blight

The Inter-American Institute of Agricultural Sciences of Costa Rica and Cornell University have named three new varieties of high-yielding potatoes which are resistant to late blight. The fungus causing the disease known as late blight is a limiting factor in the production of potatoes in the tropics and elsewhere. The best solution to the problem, and in many cases the only solution, is to obtain immune or resistant varieties.

The names of the new varieties are Ticanel, Rosanel and Güetar. These were the best selections from a group of breeding material given to the Institute in 1947 by Drs. Donald Reddick and L. C. Peterson of Cornell University. The variety Ticanel derives its name from 'tica' for Costa Rica and from 'nel' for Cornell. The tubers of this variety are white, elongated in shape and have shallow eyes. The plants have few stems. The name Rosanel indicates the rose colour of the skin of the potato. The foliage is dark green; the leaflets are medium to small in size. The flowers are purple. The tubers are round and flattened in shape and are of good eating quality; however, they are not suitable for storing under most conditions. The Güetar variety is named after the Güetar Indians who inhabited the Cartago Valley of Costa Rica. The oval to round, thick tubers of this variety are white and of good quality. The eyes are somewhat deep especially at the apical end of the tuber. The plants have large soft leaves and light lavender flowers.

A fourth variety, Harford, named and introduced in 1947 by Reddick and Peterson in New York, is also recommended by the Inter-American Institute of Agricultural Sciences for its good adaptability to the sub-tropics. These four varieties have shown high production averages, giving yields two to three times greater than late-blight susceptible varieties, according to data obtained in experiments without fungicide applications. They are also distinguished for their high resistance to *Phytophthora infestans* which causes the late blight disease, although under certain conditions they are susceptible to strain D of the same fungus. These varieties may sometimes need fungicides for best results, although possibly fewer treatments would be required than for susceptible varieties.

WORLD CROPS

IN OUR NEXT ISSUE Part 2 of the article on **Mechanical Handling** by P. H. Southwell will appear, and N. G. Gokhale will be writing on **Natural Functions and Their Influence on Tea Production in North-East India. An International Organisation for the Control of the Red Locust** will be described by D. F. Vesey-FitzGerald. There will also be other articles in this issue besides the usual features.

Increasing the World's Food Supply
The Domestication of Fish

ELI SCHWARTZ

Michigan State College

The cultivation of fish under artificial conditions in ponds is a practice which has its roots in antiquity: its revival as a means of increasing food supplies in a world of rapidly increasing populations is receiving attention in many countries.

PESSIMISTIC experts are fond of predicting that mankind will shortly eat itself off the face of the globe. However, people persist in discovering new techniques which offer hopes of survival. One such hope lies in the possibilities of fish farming, in the raising of both salt- and fresh-water fish in controlled environments. In fact, even today, in many countries people raise fish almost as we raise poultry. This domestication of the fish promises not only to add to the total supply of food-deficit areas, but even more importantly it holds the promise of improving the quality of the diet. For, contrary to popular belief, the current world food problem is not so much one of absolute shortages as of diets which are nutritionally inadequate.

Dietetic deficiencies

Millions of people in the Middle East, Africa, South-East Asia, Latin America and the United States' south are retarded in the full use of their physical and mental capabilities because their diet is insufficient in vitamins, minerals and proteins. Specifically, most of these people do not consume enough animal-derived protein foods. Innumerable studies have demonstrated that the productivity of these people could be raised significantly if they were fed a diet which was more adequate in the so-called ' protective foods.'

The history of fish farming

World-wide attempts to investigate the possibilities of raising the dietary standard of people have brought about a revival of interest in the potentialities of the ancient industry of fish farming. Fish farming, or fish pond culture, was well known to the Romans. As a matter of fact, considerable citation of the practice may be found in Roman tracts on agriculture. The Romans had both salt-water and fresh-water fish ponds, although Varro (a Roman historian) states that only the fresh-water variety was really reasonable or economical and that the salt-water fish ponds were only a hobby or plaything for the very rich.

Fish pond culture flourished in England and Western Europe throughout the medieval period. Generally, the carp ponds belonged to the lord of the manor and the peasants were prohibited from poaching. Carp, which is today looked down upon as a coarse fish in England and the United States, was lauded as the noble carp in those days, and a dish of baked carp often decorated the banquet table of the feudal lords. In fact, the lowly carp was then so highly esteemed that poets wrote of his gaiety in the spring mating season. Interesting tales are related of the rites adopted in early European fish pond culture. The female carp was annointed with a mixture of honey and sweet-smelling herbs before being placed in the breeding pond so that she might be fertile and the carp farmer prosper.

Medieval fish pond culture was unable to withstand the competition which ensued when eventually the fertile fishing grounds of the North Atlantic became open to the fishing boats of the Western European countries. Carp pond culture retreated to Eastern Germany, Poland and the Balkans. However, in China and the rest of the Orient, fish pond culture dates way back and never ceased to be an important means of supplementing the oriental diet. Here both fresh- and salt-water varieties of fish are raised and the Chinese especially have, through century-old practices, developed methods of utilising the capabilities of the ponds to produce tremendous outputs.

Efforts to revive fish culture

However, though the history of pond culture in both Europe and Asia is traced from antiquity, it is only recently that efforts have been made to compile and co-ordinate information on this type of food raising. Experiments have been initiated to see what results can be obtained using more scientific methods and some attempts have been made to encourage the extension of fish farming to other areas of the world which may be short of protein foods.

Thus, for example, a major recommendation of the 1949 UN mission of technological assistance to Haiti was that

Fish breeding operations in a Javanese pool

a start be made towards investigating the possibilities of pond fish culture for Haiti. The mission's recommendation was later implemented with the discovery of an Asian fish which may be quite amenable to domestication in the Haitian waters. Other literature on this subject has appeared in Mexico, where Senor J. Alvarez, Mexican scientist, recently published an article tracing the history and science of pond culture. He is certain that the practice could be introduced most profitably into Mexico and furnish the rural people of Mexico with a worthwhile addition to their food supply.

The Food and Agriculture Organisation of the United Nations is also actively interested in the development of this industry. It is known that the fishery advisor to the Colonial Office of the United Kingdom has recommended the setting aside of large tracts of land near Penang in Malaya for the building of experimental ponds and the organisation of a research station devoted entirely to investigations and the improvement of the practice.

Reasons for growing interest

The reasons for this growing interest in pond fish culture are quite simple. Fish farming can be conducted on land which is unsuitable or marginal for other agricultural uses. It can be started on inland swamplands, marshlands or eroded lands. As a matter of fact, a properly managed fish pond will do much to hold up the further spread of erosion. Moreover, the yield of fish per acre of cultivated pond is very high. Whereas the yield of fish in natural productive waters seldom exceeds 15 to 100 lb. per annum per acre, the type of fish culture emphasised by the American experts, for example, yields above 200 lb. per acre in fertilised ponds. In China, where 'coarse fish' (*i.e.* carp) are raised, the yield has been as high as 5,000 lb. per acre.

Although it is not probable that fish ponds in the United States are likely to attain any immediate economic significance, pond-culture experts at such schools as Michigan State College conceive a great long-run value in spreading knowledge of these techniques to the American farmer. They believe that aquiculture in the United States holds the key to an enormous potential backlog of an easily digested protein food supply which could be of tremendous importance in time of war or other emergency.

Conversion ratio

A most amazing feature of fish farming is the highly rewarding conversion ratio. The conversion ratio is the amount of feed which an animal must consume to be converted into a pound increase in that weight of the animal. The hog, which is one of our most efficient animals in this respect, has a conversion ratio of about 5 to 1 under good conditions. That is, roughly it takes a little over 500 lb. of corn to raise 100 lb. of pig. This ratio is only achieved under optimum conditions, on a high-caloric diet of corn and supplementary feeds.

On the other hand, the conversion ratio has been brought down as low as 1.9 to 1 in Japan where the carp have been fed silkworm pupae. Even the Chinese carp farmers, using cheap feed, achieve a ratio of 3.67 to 1. The Chinese forage contains a high percentage of weeds, farm and household waste, and manure. Some varieties of carp, especially the grass carp, feed upon the weeds directly. The grass is placed within a ring of bamboo, which is floated upon the surface of the lake so that the forage will not be dispersed and wasted. The fish do not actually feed upon the manure and other organic wastes which form part of the forage. These are put into the pond to fertilise the water, inducing a heavy growth of plankton which nourishes the fish population. In general, because of the low conversion ratio and the low cost of the forage mix, fish farming is perhaps the cheapest method of all of producing a given quantity of protein food.

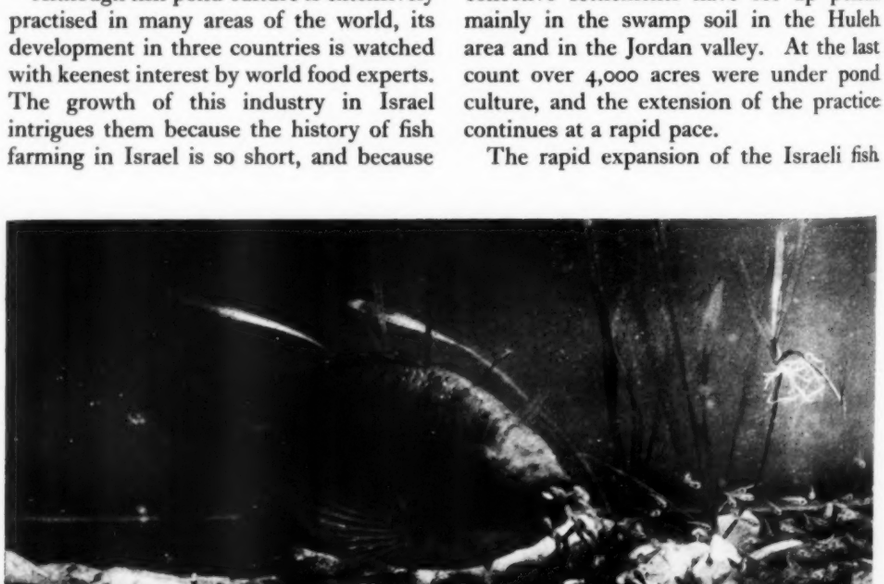
Although fish pond culture is extensively practised in many areas of the world, its development in three countries is watched with keenest interest by world food experts. The growth of this industry in Israel intrigues them because the history of fish farming in Israel is so short, and because the survival of the transplanted technique demonstrates that, given the will, new methods of food growing can be successful in a new environment. Pond culture in China is worthy of special attention because of the antiquity of the practice and because of the methods perfected by the Chinese to bring about a high yield. The third country is the Philippines, because of the government's organised efforts to encourage expansion of the industry and because of the prevalence of salt-water pond culture, a first step to the age-old dream of somehow cultivating the ocean.

Fish farming in Israel

In the new nation of Israel the product of the fish ponds is an integral part of the food supply. Nevertheless, fish farming in Israel is of recent origin. In 1937, a few Yugoslavian immigrants brought some carp with them. The growth of these in the mild climate of Palestine was amazing; the yield was two or three times as great as the 300 or 400 lb. per acre with which European pond fish farmers were contented.

By 1940-41, the annual production was close to 85,000 lb. The latest carp harvest approached 6,000,000 lb. This is the largest part of the domestically produced fish supply, since the total catch of fish in Israel is approximately 8,500,000 lb. The total supply of all fish, including imports, is approximately 16,000,000 lb. Over 56 collective settlements have set up ponds mainly in the swamp soil in the Huleh area and in the Jordan valley. At the last count over 4,000 acres were under pond culture, and the extension of the practice continues at a rapid pace.

The rapid expansion of the Israeli fish



Carp fry seek shelter in their mother's mouth when they are frightened. Here a group of fry are swimming for safety, alarmed by the photographer's flash

Carp are being successfully cultured by vegetable growers in drainage ditches on their farms

pond industry is not surprising. The social and economic climate in Palestine was as favourable as the physical one for the extension of fish farming. To many of the colonists all agricultural techniques were unfamiliar to begin with and, therefore, fish farming on a large scale hardly seemed to be a startling innovation. These people had not yet developed the distrust with which so many farmers over the world greet 'silly experiments.' Furthermore, carp (the fish best adapted to fresh-water cultivation) found a ready market in Palestine. Carp is a valued item of diet in most of Continental Europe; the Jewish people especially enjoy it because it is the main ingredient of a traditional Friday-night dish. In fact, the demand conditions were just right in that the Jews, a fish-loving people, had come into a land whose resources of wild fish were relatively low, and because the war seriously cut the supply of alternative imported protein foods.

A large-scale enterprise

Fish farming in Israel is maintained as a fairly large-scale enterprise. Each unit is broken down into different ponds; there are breeding ponds, raising ponds and cleansing ponds. In the mild climate of Israel, two crops can be raised each year. In the breeding season, a healthy female is placed in a small breeding pond with two lively males. The wooing is rather rough. The males butt and rub against the female until she is induced to lay the eggs. The fry are eventually collected and placed in the raising pond. There they are kept until they reach the market size of 1 to 4 lb. The cleansing ponds are really small basins of clear water in which the marketable fish are placed for a brief period so that they may be washed clean of mud and other debris of the raising pond. From the cleansing ponds the fish are brought to market alive in stake trucks upon which a canvas is draped. The canvas is filled with water, and in this primitive but very effective manner the fish can survive trips of up to three or four hours.

Place in a mixed farming economy

The very factors which encouraged the development of fish farming in Israel exist in many other parts of the semi-tropics. Fish farming can be made an integral part of a mixed farming economy. It is adaptable in places where the soil is relatively infertile and, as a matter of fact, use of the land for fish farming often raises its fertility so that in alternate periods the pond area can be drained, ploughed and planted, and then turned back to pond culture at a later time. This method brings about higher yields in both uses. Fish farming is also readily adaptable in irrigated areas, since the irrigation system can attain secondary importance as a place in which to raise fish.

Low cost

Another great advantage in the development of this technique is the low amount of basic capital required. The major initial cost is the construction of the pond. This construction is relatively uncomplicated and can generally be done with the use of simple earth-moving machinery. Thereafter, no expensive farm machinery is needed or required and the cost of the breeding stock is only a few dollars.

The Israeli experience shows that the first year's yield of fish is likely to be equal to the construction cost of the pond. The estimated capital cost of developing an acre of fish pond at the last count was about $672. Since the average annual physical return of an acre of pond was about 1,373 lb., or in money terms some $659, it is obvious that the major costs of fish culture are not capital costs, but variable costs—an important consideration to all countries where capital is for the moment relatively scarce.

Fish farming in China

While the Israeli experience is interesting from the point of view of the adaptability of this technique to areas where it has never existed before, it is the Chinese who possibly have the greatest experience in fish ponds and have achieved the most scientific use of the pond waters to develop a high yield. The surprising yield of the Chinese fish ponds—up to 5,000 lb. per acre—is due to a well-developed technique in which the feeding habits of various varieties of carp are so utilised that the food potential of the pond is exploited to the fullest.

Types of fish

The various layers of the pond water each support a type of fish whose feeding habits are somewhat different. The surface layer of the pond will be inhabited, for example, by the so-called grass carp which feeds on weeds and other forage, whereas the bottom layer supports the mud carp which finds its diet in the manner indicated by its name. The varieties of fish are so stocked that the surface feeders, bottom feeders and scavengers are in proper ratio to each other. These ratios are traditional, but it is hoped that, perhaps through research, proper ratios might be determined for other countries.

Fry sorting

There has also arisen in China a group of skilled fry sorters, people who can separate the various varieties of baby carp and mix them in the proper percentage to be stocked in the ponds. The basis of this technique lies in the fact that the various varieties of baby fish differ in their oxygen needs. If the fish are kept for a time in a jug, the fry move to the surface as the water begins to lose oxygen content. If a small amount of fresh water is then poured into the jug, those varieties that can subsist on less oxygen drop to the bottom, while that variety whose oxygen needs are still not satisfied remains at the top; it is then skimmed off and put into another jug. Through successive small

dosages of oxygen-containing water, all the varieties can be skimmed off one by one, according to its desire or need for oxygen.

Unfortunately, many of the best varieties of Chinese carp do not breed in captivity, and the fry of the wild species must be captured along the river banks in order to stock the fish ponds. However, since the fry were formerly distributed all over pre-war China by railroad and plane, it may be possible that in more normal times the most valuable of the Chinese species of fry can be exported by air to other countries.

Salt water fish farming in South-East Asia

In South-East Asia fish farming is somewhat newer than it is on the Asiatic mainland. Although the carp is raised extensively, the favourite fresh-water fish is the gorami, a larger-sized edition of a fish which sometimes appears in home aquariums. However, in Indonesia and in the Philippines the most interesting aspect of pond culture is the prevalence of salt-water fish farming, the raising of tidal-water fishes such as the mullet or bango. This type of farming puts to use salt-water marshland and mangrove swamps which otherwise would have no value.

The most popular fish in the Philippines is the bango or milk fish. Although neither the mullet nor bango are likely to exceed yields of 800 lb. per acre, the great advantage of the salt-water fishes is that they do not need to be fed under cultivation. The tidal-water ponds are especially prepared before the introduction of the fry to furnish a favourable environment. This is achieved by holding the water depth of the raising pond to a few inches for some weeks, causing a heavy growth of lab-lab (sea moss or algae) upon which the bangos feed. The ponds are then flooded to a depth of 3 or 4 ft. before being stocked with the fry, which must be gathered wild, since neither the bango nor mullet breed in captivity. Some experiments have been made which point to the possibility of bringing about a heavier yield of fish by fertilising the pond, inducing a heavier growth of fish forage.

Developments in the Philippines

Because of the existence of large areas of potential fish ponds, and because the growth of population has increased pressure upon the food supplies, the Philippine Government gives strong encouragement to the fish pond industry. The Bureau of Fisheries of the Philippines is ready to give technical advice and demonstrate the more improved methods of fish pond culture and construction to all those venturing into the field. The Government has large areas of salt- and fresh-water swamps which it rents at a nominal charge to those who will develop these areas into productive fish ponds.

Nai Boon Indrambarya, director-general of the Department of Fisheries of Thailand, supervises the distribution of carp fingerlings to villagers in the district of Nakori Chasri

The Philippine Bureau of Agriculture has released a pamphlet showing that a properly constructed pond for the raising of gorami will yield close to 39% on the invested capital—after all expenses, including labour, are taken out. This figure is undoubtedly somewhat exaggerated, but indicative of the profitability of fish farming is the growth in productive pond acreage since the liberation. In 1939, there were about 150,000 acres of regularly constructed fish ponds of all types. The latest figure shows over 160,000 acres in production, and almost all of the increase has come since 1945. Actually, a great deal of acreage went out of production during the Japanese occupation.

Nevertheless, the latest survey shows undeveloped swamp land of some 400,000 acres of fresh water and 1,000,000 acres of salt-water mangrove swamps, a total of some 1,400,000 acres of potential fish ponds. If this acreage were suitably developed and yielded similarly to the present ponds, a total of 440 million lb. of fish could be added to the Philippine food supply and this would allow an increase of one-third in the present Philipino consumption of fish from all sources.

Areas of potential expansion

The areas where the expansion of fish farming has the greatest potentialities lie in South-East Asia, the Middle East, the Caribbean, tropical and semi-tropical Latin America and perhaps in Africa. The tropics, in general, have scanty resources of wild fish, not enough to encourage a real commercial fishing industry. Furthermore, these countries do not have optimum conditions for the raising of livestock.

If the productive possibilities of the swamps, marshes and salt-water flat lands of these areas were utilised, the output of fish could be enough to correct the carbohydrate unbalance of the tropical diet. The resultant increase in the amount of physical labour of which the tropical populations are capable will raise the economic well-being of these people in a myriad other ways. By the domestication of fish, fish farming, a practice almost abandoned by the West, may be resurrected and help break the miserable chain of poor diet, low physical output and more poverty which is the lot of half of the world.

Photos : FAO

Murphy Spraying Programme

We have received from the Murphy Chemical Co. a copy of this year's issue of their Complete Spraying Programme. As usual this is an excellent and useful production giving details for the control of the principal crop pests encountered in this country and details of the methods of formulating various products of the Company.

The Sugar Industry in India

S. RAMANATH

Sugar has always been an important crop in India, but the expansion of sugar production is one of the most remarkable developments of the past twenty years. In this article an account is given of the industry and the manner of its extension to its present proportions.

THE sugar industry is considered to be the second largest industry in India, next only in importance to cotton textiles. Sugar cane occupies a prominent place in the rotation of crops in large tracts of North and South India. Cane has been grown in India from time immemorial. Chinese writers of the 8th century B.C. have recorded that knowledge of sugar cane and its products was obtained from India and Chinese agents came to India in A.D. 600 to learn the art of sugar manufacture.

Area cultivated

The area under sugar cane in India is larger than any other country, amounting to 4 million acres, but compared to other countries the average yield per acre is very low due to the poor quality of the cane. The main agricultural problems of the industry in India are (1) to increase the yield of cane per acre, (2) to improve the quality of cane and (3) to reduce the cost of cultivation.

Increasing cane yields

In regard to the question of increasing yields of cane per acre, it should be noted that, apart from climatic limitations, uneconomic holdings of land, illiteracy of the cultivators, defective and outmoded methods of agriculture, etc., are some of the serious handicaps peculiar to this country. The average yield of sugar cane per acre in India is between 13 and 14 tons and the yield of sugar per acre about 1.4 tons. Compared with 62 tons in Hawaii and 56 tons in Java, the Indian average yield is very low. The result of prize plot competitions conducted in parts of the Deccan and South India disclosed immense possibilities of increasing the yield per acre. In the latest competition held under the auspices of the Deccan Sugar Technologists' Association the winner of the first prize secured from a 10-acre plot as much as 106.4 tons of cane per acre, which yielded 13.2 tons of sugar. This high yield of cane per acre compares favourably with the average yield obtained by selected growers in various states. In Bombay, for instance, yields of sugar cane per acre in the Deccan canal area during 1951-52 amounted to 40.5 tons, in the Karnatak tract to 23.8 tons, and in Madras to 33.5 tons; in Uttar Pradesh, which is the largest sugar-producing state in the country, it was as low as 18.4 tons.

Random sample surveys for obtaining estimates of sugar cane yields in Bihar initiated by the Central Sugar Cane Research Station showed that the average acre yields in the different reserved areas varied from 11.9 tons to 25.1 tons in 1950-51, 12.5 tons to 25.9 tons in 1951-52, and from 13.2 tons to 30 tons during 1952-53. The results of competitions held on fairly big plots show, however, that these yields can be raised very substantially if scientific methods of cultivation are followed. With adequate irrigation facilities, sufficient manure and good cultivation, yields of 60 tons per acre and more can be obtained. The Indian Central Sugar Cane Committee launched a five-year plan in 1948 for the development of the industry and a special grant of Rs. 75 lakhs was made by the Central Government out of the sugar excise duty. There has since been an appreciable increase in the average yield of cane per acre in each state. According to the Planning Commission plans for sugar cane cultivation, an increased output of sugar cane equivalent to 703,000 tons of sugar is envisaged, to be secured by more intensive cultivation.

The quality of Indian sugar cane

The sucrose content of cane should be fairly uniform throughout the crushing season, and not very low at the beginning and towards the end of the season as at present. In order to improve the quality of cane, the ratoons and early varieties will generally have to be crushed in the early part of the season. The method of payment for canes in India is on the basis of weight, as there is no suitable organisation in the country to carry out chemical analysis of canes as in other sugar-producing countries whose sugar canes are paid for on quality. In order to improve the quality of cane, the industry has appealed to the State Governments to spend the entire proceeds of the excise duty on the improvement of cane. It is estimated that the cess collections of the Government in Uttar Pradesh and Bihar alone would be over Rs. 30 crores. The actual amount spent by these Governments on cane improvement at present is comparatively negligible. On the other hand, the sugar mills are asked to encourage the

Cane being loaded in the field

production of better qualities of cane by offering higher prices.

Any improvement in the yield of cane and in its quality will certainly bring about a fall in the cost of production.

Sugar cane co-operatives

With the increase in the number of sugar factories the problem of getting supplies of cane with high sucrose content has become acute, as there is no organisation at present for the development and improvement of cane growing or for marketing the crop. The problem has been to mould a primitive agricultural economy to meet the needs of the sugar factories and protect the interest of the cultivators. The Sugar Factories Control Act passed in 1938 in Uttar Pradesh gave a great fillip to the growth of cane co-operative societies. Areas were demarcated and reserved for exclusive supply of cane to the factories. Cane growers were organised and today there are 110 societies with 1,300,000 members extending to 97% of the factory areas, compared to that of 36 cane co-operatives with a membership of 100,000 in 1936.

The cane co-operatives were started originally with the object of marketing cane and the development and improvement of cane cultivation was added to their functions later. Today their work has developed into a village movement; the societies have justified their existence and are part of the living stream of village surroundings.

The improvement of cane cultivation

Measures for the improvement of cane cultivation have included the supply of improved cane varieties, manure and fertilisers, improving irrigation facilities and checking and controlling sugar cane pests and diseases. The total distribution of improved varieties amounts to 30 lakh maunds a year and the cost of manure and fertilisers distributed to cultivators is now Rs. 1 crore a year. On the irrigation side, 22 tubewells have been sunk in the cane areas of Uttar Pradesh in addition to the construction of thousands of masonry wells and the installation of numerous pumping plants and Persian wheels.

The societies prepare statements of yields after surveying the fields of each cultivator and enter into contracts with the factories, which are thus assured regular supplies of cane. Financial aid for the societies has come almost wholly from the cultivators' own resources and in a few cases from the mills as well. When the scheme started a levy of one pie per maund was made on all cane brought for crushing; this has steadily risen to the present rate of 9 pies per maund. With the flow of funds, rural welfare schemes have spread out in various directions. Roads, culverts and bridges have been built to improve sugar cane traffic; schools, colleges and buildings costing laks of rupees came into existence. Today cane co-operatives in U.P. run two intermediate colleges, 14 high schools, 106 aided schools and have started nearly 100 schools for boys and girls, 12 libraries and 18 hospitals. There are, in addition, several maternity centres and over 40,000 villages are treated free for several simple ailments through a large number of medicine chests which are in charge of village headmen.

Bullock carts arriving at a factory loaded with sugar cane

In order to ensure the rational distribution of sugar cane to factories and the development of the industry on scientific lines and to protect the interest of cane growers and the industry alike, the U.P. Government has enacted a Bill known as the U.P. Sugar Cane Bill.

In Bihar there has been a marked improvement in cane supply to factories during the last two years and further improvement is expected as irrigation facilities increase and cane development work becomes more intensive. The State Government's scheme for sinking 300 tubewells in the sugar factory areas in North Bihar at a cost of Rs. 3 crores is almost complete. The work has been finished in Champaran, Muzaffarpur and Darbhanga districts and is nearing completion in Saran. Schemes for the improvement of roads in these areas are also ready for execution and work is expected to start soon.

Protection

Until 1931-32 India was largely dependent on imports of sugar for her requirements, especially from Java, where imports amounted to 1 million tons annually valued at about Rs. 15 crores. With a view to developing the sugar industry of the country, the Government of India decided to grant tariff protection to the Indian industry and in 1932 the Sugar Industry Protection Act was passed, which guaranteed protection for an initial period of 14 years ending March 31, 1946. Subsequently the Government acceded to the demands of the industry for continued protection till March 31, 1950. As a result of protection India emerged for the first time in 1951-52 as an exporter of sugar and a Sugar Export Advisory Committee was appointed to suggest ways and means of stimulating exports. It recommended that 200,000 tons of sugar should be exported below the marginal cost of production and that the loss so sustained could be made up by raising the internal price in order to compete with other countries and to stabilise the industry. Exporting at reduced rates to suit the world market at the cost of the Indian consumer was, however, considered to be too heavy a sacrifice after 20 years' protection to the industry, and the Government of India on January 30, 1953, prohibited the export of sugar and gur except where firm contracts of sale had previously been made. The stampede for profits that followed protection had, in fact, prevented the industry from consolidating itself and in order to arrest the upward trend of prices the Government of India took the following measures:

(1) Sugar factories were warned against any attempt to hold back controlled sugar.

(2) Sugar from the reserve stock of factories was released at a statutory ex-factory price.

A sugar cane factory in the Deccan, South India

(3) Special trains were run to move sugar and stock at important centres.

(4) Sugar is again being imported from abroad and licences have been granted.

(5) The import duty on sugar has been reduced.

Recent developments

Later, on July 8, 1953, the Government of India announced that sugar would be imported into the country only on Government account, as it was feared that large profits might go into the pockets of importers and the main object of importing sugar, namely, to bring down the prices to a reasonable level, would be defeated. In accordance with this announcement, the Government have imported 250,000 tons of sugar valued at Rs. 17 crores during the year 1953.

During the current year 1954 the import target may reach 400,000 tons, as mentioned in Parliament some time back. This probably indicated the highest possible upper limit of imports. If the expected yield of about 1.3 million tons fructifies, the available sugar during 1953-54 will amount to about 1.6 million tons. The balance comprises carry-over and imports. This amount, it is hoped, would not only suffice for the current year's requirements, but would leave a little balance. The landed cost of imported sugar would be about Rs. 26-8-0 per maund, whereas the price in India is about Rs. 30/- per maund. The sugar deal in 1953 has yielded a handsome profit to the Government.

TABLE 1

	1949-50	1950-51	1951-52	1952-53
	tons	*tons*	*tons*	*tons*
Uttar Pradesh	508,000	592,000	834,000	679,000
Bihar	222,000	225,000	224,000	274,000
Bombay	111,000	122,000	158,000	137,000
Madras	59,000	91,000	99,000	81,000
Hyderabad	20,000	24,000	39,000	42,000
Mysore	17,000	22,000	37,000	28,000
Other states	37,000	46,000	91,000	77,000
	974,000	1,122,000	1,482,000	1,318,000

The crushing process. The canes are drawn into the chamber from which they emerge as crushed pulp

Growth of the industry

Tremendous strides were made by the industry during the years of protection, as shown by the fact that the number of operating mills increased from 31 factories in 1931-32 to 158 in 1952-53; the tonnage of cane crushed increased from 1,784,000 tons per season in 1932-33 to 15,500,000 in 1951-52; the total sugar production increased 158,000 tons in 1932-33 to 1,482,000 in 1951-52 and 1,318,000 tons in 1952-53.

Sugar production

The production of sugar has, however, failed to keep pace with the increase in consumption, with the result that there has been scarcity of supplies in several centres and undue rise in prices, which compelled the Government of India to import sugar. Compared with the record output of 1,482,000 tons in 1951-52, there was a decline of 12.7% during the last season. Table 1 indicates the trend of production in seven different states during the last four seasons.

Except Bihar and Hyderabad, all other states showed a fall in production last season. This was due chiefly to the difficulty experienced by mills in getting adequate supplies of cane due to the diversion of cane to the manufacture of gur* in that year. In India the sugar industry and gur industry are interdependent. Because of the low price of gur in 1951-52, there was diversion of cane from gur making to sugar making, which resulted in a record production of sugar of about 15

* Gur is a low-grade concrete sugar made by Indian peasants by concentrating cane juice extracted in primitive mills in open pans over open fires until it solidifies.

lakh tons. But owing to low prices for gur, the demand for sugar fell to about 12 lakh tons, which resulted in a carry-over of sugar to the next year. As a result of low gur prices in 1951-52, the supplies of gur available for 1952-53 became inadequate. There is always considerable demand for gur for consumption and for the manufacture of illicit liquor. Another factor responsible for the fall in production is the low yield of sugar cane in the year 1952-53. The aggregate yield of sugar cane during 1952-53 is estimated at 50.35 million tons, as against 58.95 million tons in 1951-52.

Cane consumption

That the factories experienced a shortage of cane supplies during the last season (1952-53) is borne out by the lower consumption of cane by the factories. The quantity of cane actually crushed amounted to 13 million tons, as against 15.5 million tons in the previous season. Out of 158 sugar factories in India, only 134 factories worked during the season, as against 139 factories in the previous season, while the average number of factory working days in 1952-53 was 112, as against 133 in the previous year.

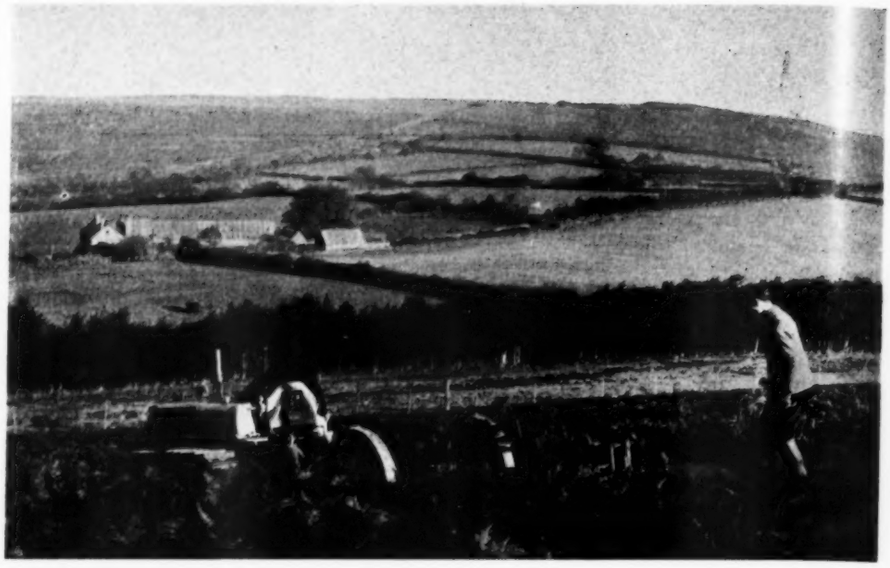
Although the quantity of cane crushed in the factories decreased by 16%, there was an improvement in the percentage recovery of sugar, which was slightly higher at 10.01 improvement in quality, as compared to 9.57 in 1951-52. This increase is not due, however, to the cane, but should be attributed to the late start of the crushing operations, when the sugar content of cane is generally higher. The recovery percentage in India is the lowest compared to other sugar-producing countries in the world.

Conclusion

According to the five-year plan of the Government of India, the programme for the development of the sugar industry is as follows:

	1950-51	1955-56
Number of factories ..	158	160
Annual rated capacity in millions of tons of sugar	1.54	1.55
Actual production ..	1.12	—

In the first year of the plan (1951-52) a peak production of 1.482 million tons of sugar was secured, a record in the history of Indian sugar industry. This was mainly due to adequate supplies of sugar cane to factories, to high prices for sugar, to improvement in transport facilities, to substantial financial assistance from the Industrial Finance Corporation and to the Government's free market policy.



Deep ploughing in progress

Deep Ploughing in Somerset

Five years ago the Dunster Castle estate in West Somerset was much in the news and eventually the greater part of it was bought by the Crown. The woodlands and potential woodlands were passed to the Forestry Commission (some of the land, including that in the photograph, adjoined the already existing Brendon Forest) and much use has been made of the Forestry Commission's deep-ploughing technique. Here one of the Commission's R.L.R. ploughs is cutting its 15-in. deep single furrows in previously unbroken land covered with heather, bracken and gorse on a north slope of Croydon Hill, about two miles from the Bristol Channel. The chief value of this work, from a forester's point of view, is that a 15-in. deep furrow normally breaks the hard pan (which may sometimes be 12 in. below the surface) and enables the roots of trees to get through to the subsoil and at the same time promotes natural drainage which is usually impeded by a hard pan. Croydon Hill is within the newly designated Exmoor National Park, though near-by Minehead is just outside.

U.S. Farm Product Surpluses

The U.S. Foreign Operations Administration has told Congress that there will be much less use of surplus United States farm commodities in FOA foreign aid programmes next year than this.

Dr. D. A. Fitzgerald, deputy to the Foreign Aid Administrator, Mr. Harold Stassen, told the Foreign Affairs Committee of the House of Representatives that the FOA expected to cut its spending from $440,900,000 in this fiscal year ending on June 30, to $250,300,000 in the new fiscal year. Cuts would be greatest in European programmes. Dr. Fitzgerald was testifying at a hearing on the Eisenhower Administration's request for foreign aid funds for the new fiscal year. He said the expected decline in spending to purchase surplus commodities was due to the fact that the Eisenhower Administration was cutting sharply its total request for military security funds—from a total of $4,700,000,000 in this fiscal year to $3,500,000,000.

Dr. Fitzgerald said it was planned to reduce allotments for European countries from nearly $242,000,000 this fiscal year to $55,000,000 in the coming year. The European cut would constitute the bulk of the reduction in spending for surpluses, he added; other areas of the world would receive about the same amount of surplus products next year as they would in this.

Meanwhile, the Secretary of Agriculture, Mr. Ezra Benson, has told a Press conference that his department will do all it can to exchange surplus farm commodities for foreign currencies. Questioned as to whether the United States would sell some of its surplus butter abroad, Mr. Benson reiterated that the Department would not sell its butter abroad at a lower price than that paid by the United States consumer.

Agriculture in Iceland

We have published in WORLD CROPS *articles on agriculture in a number of countries either within or verging on the Arctic Circle, and the following article on agriculture in Iceland is a continuation of this series. In the presence of ever-growing populations the possibilities of growing food in any part of the world, however unpromising, should not be neglected, and on this account special interest attaches to this subject.*

ICELAND is a large island lying in the North Atlantic Ocean between parallels of latitude 63° and 66° north and of longitude 13° to 24° west. Its total area is approximately 64,800 sq. km. and its population in 1949 was 141,000.

Physical characteristics

The country is very mountainous and the lowlands are chiefly located along the coasts, where they penetrate into the central highlands in the form of valleys. The basal sedimentary strata have been tilted towards the centre of the country, giving rise to a central depression filled with tuff, upon which subsequent volcanic eruptions have piled numerous layers of lava, pumice, volcanic ash and sand, which constitute in this region the main soil-forming material. In other parts of the country, where the foundation is of basalt, the soils have a greater moisture-holding capacity than those formed from pumice and volcanic ash.

Two-thirds of the surface are entirely devoid of vegetation and glaciers constitute about 13,000 sq. km. Vatnajokull, the greatest glacier in Europe, covers 8,250 sq. km. In it is the highest peak in the country, Orafajokull, which has a height of 2,119 m. Lava fields and naked mountains constitute about 25,000 sq. km., while about 30,000 sq. km. have some kind of vegetation, of which approximately one-half is estimated to be of agricultural value.

From the standpoint of agricultural utility one may roughly speak of three classes of soils: half-bog or moorland soils; well- or fairly-well-drained mineral soils, frequently of a loessial type; and sandy and gravelly soils, or soil material with a low content of organic matter and sparse, if any, vegetation. Loosely estimated, it is reasonable to suppose that uncultivated but cultivable land is not under a million hectares.

Climate

Iceland has a cold-temperate, oceanic climate with relatively warm winters and cool summers. The growing season, or frost-free period, is relatively long, often more than 120 days in the south. The length of the day in the early part of the summer favours the rate of growth. The average annual number of hours of sunshine at Reykjavik is 1,300 and at Akureyri 986. Precipitation varies a great deal, from somewhat over 400 mm. a year in some places in the north up to about 2,090 mm. where it reaches a maximum in the south.

Agriculture and land reclamation

Although only 1% of Iceland's total land area is under cultivation, agriculture is the second most important industry, and the increase in agriculture is of major importance for the overall economy of the country.

Cattle and sheep raising are the main agricultural efforts. Poultry raising and the growing of vegetables and potatoes are also of importance and are steadily increasing, making the country almost self-sufficient in this respect. In addition to 4,140 sq. km. of cultivated grassland, Iceland has almost 16,000 sq. km. of open grazing land where the sheep are turned loose during the summer.

The Icelandic Government is now trying to achieve a programme for modernising and expanding agricultural production. New machinery for the drainage of potentially arable land has been imported with the help of ECA funds and a number of projects in this field are already completed, while others are being worked on. A large number of small-wheeled tractors for individual farmers have been imported as well as a great number of other modern agricultural implements. Large drag-line excavators and bulldozers are used generally on a district-sharing basis for cultivation work, road building and irrigation.

Scientists are of the opinion that there was at one time more grassland than at present, but volcanic ashes, indiscriminate lumbering and overgrazing led to the erosion of thousands of sq. km. of grazing land. A very important part in the present government programme for increased agricultural activities is the reversal of this trend.

Special grass seeds and fencing material to keep the sheep off are being imported —much of it through Marshall Plan aid— in order to reclaim these vast areas of waste land and sand deserts. It is estimated that about 500,000 hectares of eroded land are being restored by these measures.

An Icelandic farm

The Government is following a 10-year (1951-60) programme for the development of agriculture, which is primarily concerned with land reclamation and cultivation, better housing for the rural population, and increasing the number of sheep and cattle. The International Bank granted in 1951 a loan for £360,000 for the agricultural programme and a new loan of £480,000 is being negotiated with the International Bank for the same purpose. By far the greatest part of the programme is, however, financed from local resources. Half of the initial capital of the Development Bank will be used for projects of interest to agriculture.

The general purpose of the agricultural programme is:

1. To provide the growing population with an adequate supply of dairy products and meat.
2. To reduce the need for imported feeding stuffs.
3. To increase the exports of lamb, sheep skins and wool.

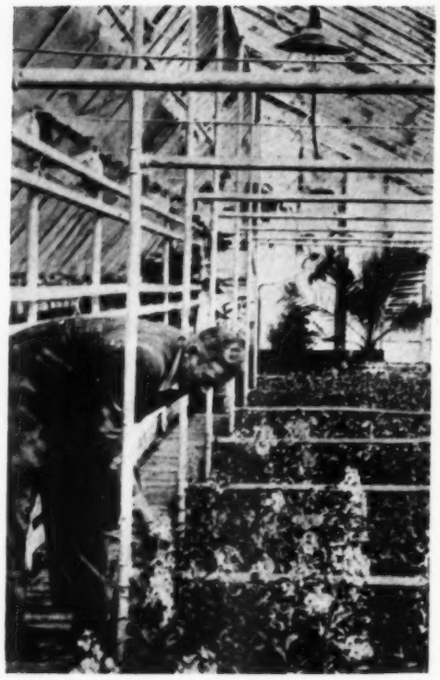
The agricultural industry

In 1910, farming was engaged in by 43,411 people or 51% of the population, and in 1950 by 28,695 or 19.9%. It is, however, to be noted that farming also benefits by a considerable amount of seasonal labour during the summer, in addition to those who are permanently engaged in the industry. The number of people engaged in farming has of late years become fewer as other industries, such as fishing on modern lines and manufacturing industries, have increased. But, in spite of the decreasing number of those engaged in farming, the production of agricultural industry has increased, and farming still plays a very important part in the national economy.

Farms and farmers

The number of farms has been estimated as follows: in 1932, 5,767 farms; 1942, 5,870; and in 1952, 5,317. These figures do not include farms within the jurisdiction of urban communities, of which there are a great number, for the towns have expanded and absorbed some of the neighbouring farms.

The number of farms is to some extent affected by the fact that some farms in remote situations have recently been abandoned while other new ones have been created, both by the splitting up of farm lands and by the rehabilitation of deserted farms. The number of farmers considerably exceeds that of the farms, as on some farms there is often more than one household.



Tending a bed in one of Iceland's greenhouses heated with almost boiling water from volcanic springs

Farming amenities

Electricity is widely used on farms. Thus current from the major generating plants had by the end of 1952 been supplied to 830 farmsteads, while 454 more obtain supplies from lesser hydraulic plants and 233 from small motor installations. In addition, quite a number of farms have electricity from wind-motor plants. In rural areas and the smaller villages 11,091 wireless receiving sets were to be found at the end of 1950, while in the whole country there were 36,374 such registered sets.

Land reclamation organisations

Under an Act of 1945, 66 land reclamation organisations have been formed which cover almost all rural areas. These farmers' organisations receive 50% State support for the buying of farm machinery such as excavators, track-laying tractors with bulldozers, heavy-duty ploughs and harrows, etc., for reclamation work.

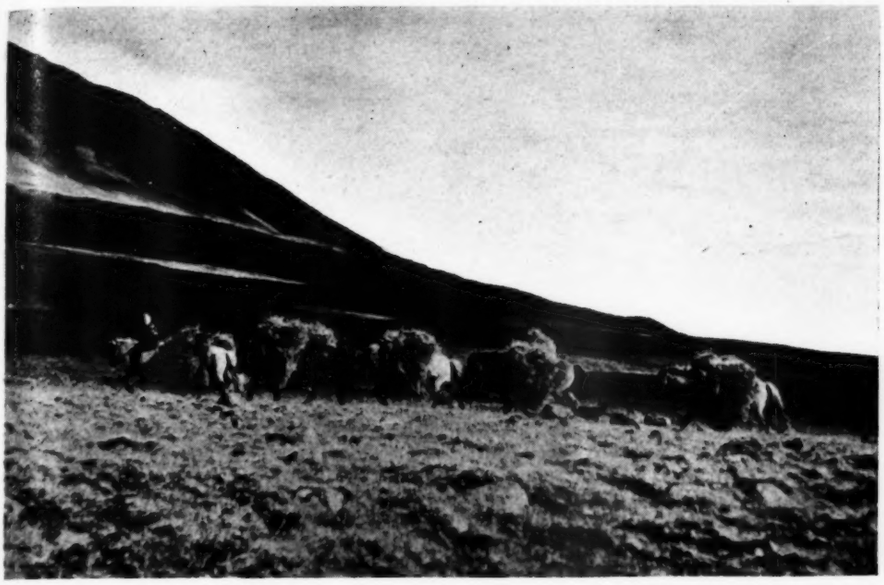
Aided by the Government, these organisations had by the end of 1952 acquired 10 excavators (dragline type), 108 track-laying tractors (practically all with hydraulic bull-graders or bulldozers), 32 wheel tractors, 21 mole ploughs, 55 breaker ploughs, 44 other ploughs, 151 heavy-duty harrows and 11 land levellers. State aid for the acquisition of this machinery has reached a total of Kr. 4,803,313.

Drainage

A very great deal of the land that comes under consideration for reclamation is bog or moorland and must be drained. The foundation for large-scale enterprise in this direction was laid in 1943 by the Government Agricultural Engineering Service Act. Under this, the Treasury has disbursed funds for buying excavators up to a total amount of Kr. 4,125,000, and 43 excavators are at present in operation on drainage enterprises.

These excavators dig open drainage trenches and, in the course of the ten years 1942-52, 2,384 km. (1,480 miles) of trench have been dug with a total cubic capacity of 8,988,832 cu. m. (11,685,480 cu. yds.) at a cost of about 20 million kroner.

Haymaking near Akuyerie on the Arctic Circle in Iceland



Icelandic ponies carrying hay from the fields to the farm

Farm mechanisation

Of late years farmers have acquired agricultural machinery on a relatively large scale.

The importation of wheel tractors in 1942 was six machines; in 1952, 498 machines were imported. At the end of 1952, records showed farmers to be in possession of 2,276 wheel tractors plus 112 small garden tractors and rototillers. The principal tractor implements bought by farmers of late years have included 1,069 tractor ploughs and disc ploughs, 1,260 tractor harrows, 1,872 tractor mowers, 846 hay tedders, 77 tractor rakes, 66 side rakes and tedders, 81 hay loaders, 169 manure spreaders, 435 potato diggers, etc.

The horse-drawn implements owned by farmers included 1,141 ploughs, 1,482 harrows, 3,115 grassland harrows, 935 fertiliser distributors, 4,328 mowers, 3,672 rakes, 1,816 tedders, 410 side rakes and tedders, etc. Milking machines are installed on about 850 farms.

A fertiliser plant is now in course of construction and production is expected to begin this year. The plant is built for producing annually some 6,000 tons of nitrogen (N) as ammonium nitrate 33.5%. The total cost is estimated to be approximately 118 million kroners. The plant is built and will be run by a limited liability company. The share capital amounts to 10 million kroners, of which the Icelandic State holds 60% and other shareholders (Icelandic) 40%.

Cultivated and reclaimed land

Under the Cultivation Act of 1923 and its subsequent amendments, very substantial grants are made to extend and improve cultivation of the soil and to help to bring about other improvements on the farms, *e.g.* the building of silos, storage for farmyard manure, etc.

In 1951 the area of land reclamation, including levelling manured but hillocky fields, was 3,141 hectares, while the aggregate State grants for various agricultural improvements amounted to Kr. 7,711,000.

Hay crop

Hay is harvested not only on cultivated fields but also in uncultivated meadow land; in some places this is irrigated by rivers that carry glacial deposits. With the expansion of cultivation, haymaking on meadows has dwindled.

Of late years many farmers have provided themselves with barn driers, so far about 700, which enable them to dry a considerable portion of their hay crop.

Potatoes

Potatoes are an important item of consumption and production in Iceland, but total production is insufficient to meet local needs and there are appreciable annual imports.

The potato crop depends very much upon the weather and may suffer heavily in many parts of the country; the south-west coast is in this respect the most favoured part of the country. When spring comes late, crops may be expected to be poor, and night frosts in the summer may do great harm, *e.g.* when they come in August. Crops and imports of potatoes have been as follows, counted in tons: 1936-40 (averages), home crop 7,974, imports 1,108; 1953, home crops 15,000, imports 2,650.

Greenhouse cultivation and vegetable growing

A certain amount of vegetables are grown out in the open such as white cabbage, cauliflower, kale, carrots, radishes, lettuce, swedes, etc. Greenhouses, heated with either water or steam from the volcanic hot springs, have of late become fairly common. The first of these was built in 1924.

In 1940 the area of greenhouses was reckoned at approximately 10,000 sq. m., but in 1950 it had risen to 73,000 sq. m.

In addition to floriculture, which is financially important for the owners, the staple greenhouse products are tomatoes and cucumbers. In 1940, tomatoes grown in greenhouses amounted to 85 tons and cucumbers to 6 tons, while in 1952 these figures had risen to 200 tons and 40 tons, respectively. Grapes, bananas and some other species of that kind are also cultivated in greenhouses.

Cereals

Properly speaking, no cereals are grown in Iceland. Early-ripening varieties of barley and oats may ripen fully in the southern part of the country or even in other places, and experiments with them are in progress in experimental farms, while a few farmers in different localities attempt to grow them.

Feeding stuffs

The country produces large quantities of feeding stuffs rich in protein, for herring meal and fish meal are important products of the fishing industry and are exported. Thus the farming industry has within easy reach plenty of protein forage; on the other hand all fodder providing concentrated carbohydrates must be imported.

Livestock

Sheep breeding was formerly the principal item in farming; milk production was practised but not greatly beyond the farmer's own domestic needs. After the fishing and manufacturing industries began to develop and towns and villages grew up, however, milk production took an upswing. Since then, dairies have been built and in some districts cattle farming has become of greater importance than sheep farming, although most dairy farmers also have some sheep. The number of livestock in Iceland in 1951 has been estimated as follows (for comparison, figures for 1910 are also given): milch cows, 31,427 (in 1910, 17,483); sheep,

410,894 (578,634); horses, 41,411 (44,815); and other cattle, 12,415 (8,495).

The number of sheep has greatly decreased, as will be seen from these figures. This is primarily due to diseases that have ravaged the stock. In 1933 some Karakul sheep were imported from Germany with the object of introducing ' Persian ' lamb. The first imported sheep are considered to have brought three sheep diseases into the country which have quickly spread with disastrous consequences.

To this is also due the fact that, whereas formerly considerable quantities of frozen lamb were exported to Britain, the total meat production of late years barely sufficed to satisfy the requirements for home consumption. The number of sheep killed for marketing has been as follows: 1940, lambs 366,000, other sheep 26,900, total 392,900; 1952, lambs 215,100, other sheep 31,600, total 246,700.

Total meat production: 1940, 11,337 tons; 1952, 8,792 tons.

The gathering of sheep in autumn

Agricultural education

There are two agricultural training schools, one at Hvanneyri, in the south-west, and another at Holar, in the north. There is also a horticultural school at Reykir, in Olfus, on the southern lowlands. The staff at Hvanneyri consists of the principal and four instructors, and at Holar the principal and three instructors.

Research work

The agricultural department of the University Research Institute employs seven experts in the following branches: soil chemistry (2), plant breeding (1), plant pathology (1), entomology (1), animal feeding (1) and sheep breeding (1).

Experimental farms

Four of these are run by the Government: Samsstadir in the south, Reykholar in the west, Galtalaekur near Akureyri in the north and Skriduklaustur in the east. At these farms experimental work is carried out on tillage, manuring, the use of grass seeds and grass-growing in general, potato-growing, the growing of cereals (barley and oats), etc. In addition, the Southern Farmers' Union maintains an experimental farm for cattle breeding at Laugardaelir in the south.

The soil conservation service

Soil erosion has wrought great havoc in Iceland. In 1920 there were 10 reclamation areas, enclosed in fencing that totalled 38 km. in length, the aggregate area of the fenced-in fields being about a thousand hectares. By 1952 the number of the enclosed areas had increased to 48, the aggregate length of the fences to some 600 km. and the protected area to approximately 70,000 hectares.

The headquarters of the Soil Conservation Service are at Gunnarsholt Farm in the Rangarvellir district. Experimental work is carried out there, and from there the conservation activity throughout the country is directed.

Of late years work on reclaiming sandy wastes has been attended with great success. It has been done by fertilising liberally with phosphoric acid and nitrogen, while the seed sown is principally *Bromus inermis*, Festuca of several varieties, and Timothy grass. Erosion has also been checked in many places by sowing sea lime grass (*Elymus arenarius*).

The Tubewright

' The Tubewright,' a new film made by Stewarts and Lloyds, Ltd., outlines the progress made both in manufacturing techniques and in uses of tubular steel.

Tracing the use of the ' hollow structural member,' on which tubular steel is based, the film recalls natural examples, including the corn stalk, the bird's quill and the bamboo cane. It shows how the great British engineers of the 19th century adapted Nature's methods to steel structures, leaving behind them the tubular Menai Strait and Forth Bridges.

Then, for many years, there was little headway, the main obstacle being the difficulty of making tube-to-tube connections which were both economical and efficient. It was not until comparatively recently, when modern metallic arc welding was fully developed, that new advances were possible.

One of the most important aspects of steel tubes is their high strength-to-weight ratio. The film demonstrates the successful application of steel tubes as structural members in bridge-building, crane jibs and materials handling equipment; underlines their growing worth to the building industry, in particular when modern prefabrication techniques are applied; and records in some detail the recent construction of factories with all-welded tubular steel frames.

Training in Pest Control

Last year 28 students from countries receiving aid under the Colombo Plan came to the United Kingdom for a course of training in the latest methods of pest control with two British firms which are specialists in this technique. This year, the United Kingdom was asked to provide similar training, under the Colombo Plan Technical Co-operation Scheme, for 24 students —10 from India, six from Pakistan, five from the Philippines and three from Indonesia.

Thirteen of the trainees—five Indians, three Pakistanis, three from the Philippines and two Indonesians—are doing their training with Pest Control Ltd., at Bourn, in Cambridgeshire, and the others went to Plant Protection Ltd., at Fernhurst, near Haslemere, in Surrey.

Feeding Plants Through the Leaves

E. R. WEBBER

Of recent years considerable attention has been paid to the possibility of aiding the nutrition of plants by foliar sprays. The practice in some form is of considerable antiquity, but had fallen into disuse; it has now been revived especially in relation to applying nitrogen and also certain mineral and trace elements to crops.

IT is strange how modern science sometimes revives old horticultural practices which have fallen into disuse. Air-layering of branches is one example of this, and another—of more importance to commercial growers—is the application of fertilisers and nutrients to the plant through its leaves and shoots.

Leaf feeding in the past

Roots are usually looked upon as the main feeding sources of the plant, yet almost 200 years ago horticultural writers spoke of the application of various manurial concoctions to leaves and branches as a means of nourishing the plant.

Coming to more recent times, in 1914 foliar sprays were used in California quite successfully, but the work was discontinued as it was found that soil application of nitrogen was more easily done and just as effective. Smaller experiments went on between the two wars, but it has been in the last ten years that this ' leaf feeding ' has begun to come into its own.

Advantages of leaf feeding

What are the advantages of ' leaf feeding ' as compared with soil application?

Its chief selling point is economy. The latest techniques of combining fertilisers, insecticides or weed-killers in the one spray will save time, expense and labour. The actual application is also economical. There is practically no loss and a much smaller amount of fertiliser is needed than when applied to the soil.

The effect of the ' leaf feeding ' is said to be much quicker in the response of the crop—a day or two sometimes as compared with a week or more.

In certain circumstances, such as on wet and low-lying ground, soil application of fertiliser is practically useless and the new method has allowed crops to be grown which could never be grown before. On impoverished marshy soils, nitrogen, phosphorus and hormone weed-killer have been sprayed together with very good results. There are many acres of this kind of land in Great Britain. With fruit, nitrogen can be sprayed on in the required quantity according to the amount of fruit set. It has been used on cereals and brassicae.

Treatment of deficiencies

Foliar applications have been used for some time for the prompt treatment of deficiencies such as iron, magnesium, manganese, potassium and zinc, but the main research in this country has been concerned with the value of nitrogen spraying in orchards under grass where there is a natural tendency for the trees to become short of nitrogen.

Urea sprays for fruit trees

Urea, which is very soluble in water and extremely good for spray work, has been the form of nitrogen fertiliser most used. Urea spray is readily taken up by the leaves of both pear and apple trees and has been found quite satisfactory on blackcurrants. The spray is absorbed directly through the leaf, shoot and wood growth and the bark. Some must also, of course, find its way into the tree via the roots.

Work at Long Ashton

At the Long Ashton Research Station experiments have been carried out in a commercial orchard on Laxton's Superb bush apples on Malling No. 1 stock. The trees were 11 years old, growing in a green cover kept short by gang mowing. A 1% urea spray was used, adding ' Estol " H " ' as a wetting agent.

Treatment consisted of one, two and three post-blossom sprays respectively, applied between the beginning of June and the first week in July. The greatest increase in nitrogen was found in the trees sprayed at petal-fall—later sprays having less effect. The sprays caused no damage to the leaves. When the spray was applied before the June drop an increase in set and yield was most likely, although it is possible that there might be a reduced yield in the following year as a result.

Urea sprays can give improved fruit set, colour and yield, but if the set is heavy and the reserves of nitrogen are low the trees may produce smaller fruit and less woody growth.

American results

American experiments show that in orchards foliage sprays of urea gave yields comparable with or greater than equivalent amounts of urea applied to the soil. Post-blossom sprays using 5 lb. of urea to 100

The effect of spraying one-half of a zinc-deficient apple tree. The zinc deficiency is on the left-hand side

gal. of water appeared to give the best results.

Proprietary nutritional leaf sprays are sold in America. One of these, Rapidgro, which is a completely soluble fertiliser containing 23% nitrogen (mainly from urea), 21% phosphoric acid, 17% potassium and about a dozen other elements, seems to be very successful.

A number of applications are made at a concentration of 1 oz. to 2 gal. of water, *e.g.* five applications at intervals of seven to ten days. The spray was found to be good with street trees where the application of soil fertiliser is difficult. London plane, yew, elm, and lime all responded well. Other plants treated successfully were roses, chrysanthemums, tomatoes, azaleas and geraniums.

Trace elements and foliar sprays

Foliar sprays have been used for some years as a means of correcting deficiencies of trace elements. For a copper deficiency, the spraying of affected trees with a proprietary copper oxychloride spray at half the recommended strength as used as a summer fungicide on fruit trees is very effective, or a spray of 0.05% copper sulphate during the last week of May can be used. Both give a good control of copper deficiency in the same year as applied.

Effects of spraying a copper-deficient apple shoot

For zinc deficiency, a 4% spray of zinc sulphate in February or a 0.1% solution later in the spring will be sufficient.

Conclusion

To sum up: 'Leaf feeding' may be useful as an economy measure in these times of ever-rising costs; it may be used to correct nutrient deficiencies quickly; a more exact and prompt control of the tree may be maintained; it is particularly valuable in soil conditions in which nitrogen is not easily available to the roots either because of the nature of the soil itself (*e.g.* marshy land) or where the soil is clogged by a mulch such as sawdust. It may also be useful during dry periods when the nitrogen is again not made available to the roots.

There needs to be a good deal more work done on the subject, but it shows great promise for the future.

Photos: p. 247, Royal Horticultural Society, p. 248, Long Ashton Research Station.

Liberian Rice Production

A rice mill installed in Liberia under the supervision of an FAO Expanded Technical Assistance Programme expert is helping avert a fall in the country's rice production. The fall in rice production has not been threatened by lack of land to grow it on or by lack of men to grow it, but by the reluctance of Liberian women to pound the outer shell off the rice. In this process the rice paddy is placed in a hollowed-out log and pounded with pieces of wood. But the work is slow and very tedious. Theodore Hogan, the American rice milling expert whom FAO sent to Liberia 18 months ago, once timed three Liberian women pounding 25 lb. of rice; it took them 90 minutes to finish the task. With the steady rise in Liberia's living standards women are becoming harder to find to carry on the work at wages which the farmers can afford to pay.

Any drop in production would be very serious in Liberia where rice is the staple cereal and where between 5 and 10 million lb. must already be imported each year to supplement domestic production.

The mill set up under Mr. Hogan's supervision at Suakoko, about 125 miles from Liberia's capital of Monrovia, was equipped with funds supplied jointly by the Government of Liberia and FAO and went into operation at the beginning of this year. It has a milling capacity of 10,000 lb. per day and working at capacity can operate at a good profit in competition with home-pounded rice.

The mill breaks a much smaller proportion of the rice grains than are broken in home-pounding and in addition valuable by-products from the process are saved. In home-pounding the rice bran and the outer husks are lost in the winnowing of the grain. In the new mill the bran is saved for stock feed and the husks are separated out for fertiliser.

This mill is merely regarded as pilot project to explore the economics of machine milling, to be followed by other rice mills throughout the country if it proves a success. But already it is causing such great interest among the rice growers in the Suakoko district that many of them who had proposed reducing their rice plantings this year because of the difficulty of having the crop pounded have revised their plans. Some of them, in fact, actually plan to increase their plantings because of the installation of the mill.

At present experiments are being carried on by the all-Liberian staff at the mill to find out to how small a degree the rice can be milled and yet command a ready sale on the Liberian market. Ideally, from the nutritional point of view, only the hard, outer shell, or pericarp, should be milled off the rice grain. But the resulting grain of rice is brown and is not acceptable to the Liberian population because it is the same as the highly-nutritious rice fed to the inmates of Liberia's prisons and is therefore classed as 'prison food.'

If rice sold to the Liberians is too brown they will take it home and pound it to a pure white, and quite unnutritious, condition. So the present consumer experiments will be continued for some time to find out how brown the rice may be left from the mill and yet sell and be eaten without further home pounding.

British Purchases of Canadian Wheat

Britain, Canada's best wheat customer, purchased 123,393,000 bushels of wheat in the crop year ending July 31, 1953. This amount by far exceeded shipments to Canada's second biggest customer, West Germany, which took 24,346,000 bushels. Altogether, Canada exported 385,900,000 bushels to 70 countries during a crop year which saw Canada's wheat production reach a new record of 688,000,000 bushels.

Besides Britain and West Germany, other major markets in Western Europe were Belgium which took 20,860,000 bushels, the Netherland 15,594,000, Italy 13,570,000 and Yugoslavia 10,592,000. Other major buyers were the United States, Japan and Pakistan.

Virus Diseases of Plants in Ceylon

WILLIAM NEWTON and J. W. L. PEIRIS

Expanded Technical Assistance Programme, Agriculture Division, FAO — *Plant Pathology Division, Department of Agriculture, Peradeniya*

VIRUS disease investigations have been initiated by the Department of Agriculture of Ceylon as part of a long-range programme designed to encourage greater food production through control of plant diseases and to protect the basic estate industries of tea and cocoa, especially the latter, since disease symptoms suggestive of virus origin have been known for a long time in cocoa.

Cocoa

The recent experimental proof of the existence of a virus disease of cocoa (*Theobroma cacao*) in Ceylon has attracted attention owing to the serious effect of the virus disease, swollen shoot, upon cocoa production in the Gold Coast. However, cocoa growers of Ceylon have no reason to be greatly alarmed, as no die-back or other evidence of conspicuous injury that can be attributed to virus disease has been found. The symptoms fit closely those described by Posnette[1] of an attenuated form of 'swollen shoot.' No swellings of any kind have been found on the twigs or branches of the trees, although they bear the characteristic foliage symptoms of swollen shoot. The foliage symptoms, the vein-clearing and vein-banding are in no respect different from those described in relation to swollen shoot. The disease has been transmitted to seedlings by grafting and by mealybugs. Two species of mealybug, tentatively determined as *Pseudococcus lilacinus* and *P. citri* were established recently as the vectors by Dr. W. Carter, of FAO, and Dr. H. E. Fernando of the Ceylon Department of Agriculture.[2]

The disease is widely distributed. No plantation carrying trees of 20 years or over has been found entirely free from the disease. However, plantations of young trees under 10 years are usually free. A general relationship between the percentage of infected trees and the density of the mealybug populations suggests that the mealybugs are the principal vectors. An area where a large percentage of the trees is infected is usually surrounded by areas where the infection gradually decreases away from the centre. This distribution pattern, together with evidence that any absence of trees blocks the spread of the disease, are other factors suggesting mealybug as the principal vector.

Legumes

Two virus diseases of dhal or pigeon pea (*Cajanus cajan*) have been established recently as distinct and sap-transmissible. One has been named ' yellow mosaic ' and the other ' pale mosaic.' Yellow mosaic is characterised by a bright yellow blotchy foliage mottle which makes the diseased plants very conspicuous, but at present the disease does not appear to be greatly affecting crop yields. The number of diseased plants in the stands at the time of seed maturity rarely exceeded 10%. The distribution appears to be confined to the dry-farming areas of the north central dry belt.

The other disease, pale mosaic, characterised by vein-banding followed by a light green mottle, has been found only in the wet zone in the vicinity of Peradeniya. Unlike yellow mosaic, pale mosaic spreads rapidly. In plots where only a few infected seedlings were found early in the season, all the plants were infected when they had reached the flowering stage. The appearance of a very small percentage of infected seedlings in most plantings suggests that the disease is seed transmissible, but supporting experimental evidence is not available. In addition to the distinctiveness of the symptoms this disease can be distinguished from yellow mosaic by sap transfers to princess bean (*Psophocarpus tetragonolobus*). Inoculations with pale mosaic had no effect within 20 days, but inoculations with yellow mosaic induced conspicuous vein-banding in the newly formed foliage in 10 to 15 days, followed by a yellowish mottle.

A mosaic disease of *Crotolaria striata* and *C. hirsuta* is common in the wet zone and is sap-transmissible. The disease is characterised by vein-clearing followed by a conspicuous light green mottle. The virus causing this disease is distinct from those which cause yellow mosaic and pale mosaic of dhal, as the *Crotolaria* virus is readily transferable by sap to cowpea variety V4, upon which it induces a mosaic type of mottle. Neither of the dhal viruses induces symptoms when transferred to the same variety of cowpea. The *Crotolaria* virus is also sap-transferable to princess beans, where it causes conspicuous vein-banding symptoms that closely resemble those induced by yellow mosaic of dhal, except that the mottle which follows is not so yellow.

Mosaic diseases of lima bean (*Phaseolus lunatus*), green gram (*P. mungo*) and a leguminous weed (*P. lathyroides*) have been found in close association with yellow mosaic of dhal in the north central dry belt and are consequently suspected of being caused by the same virus. The disease of lima bean was more virulent and widespread than those of the other *Phaseolus* species.

A vein-banding virus disease of dadap (*Erythrina lithosperma*), a popular shade tree over cocoa, is of some interest. The trees are invariably infected when the cocoa trees below them are heavily infected with the cocoa vein-banding virus, whilst vein-banding is comparatively rare on dadap over cocoa that is practically free from vein-banding symptoms. The recent discovery that mealybug colonises on dadap is also of significance. Only a fraction of the leaves of infected dadap trees bear the vein-banding symptoms, and the disease does not appear to affect the vitality of the trees. The disease is not sap-transmissible and mealybug transmission trials have not been carried out.

Sweet potato

A mosaic disease of sweet potato (*Ipomoea batatas*) is quite common wherever the crop is grown and may partly account for the poor yields obtained with many varieties and for the unpopularity of the crop in Ceylon. The disease is characterised by a mosaic type of mottle with little or no leaf distortion. In the trial plots of Peradeniya the varieties Golden Yellow and White Maltese were severely infected. The disease was readily transmitted to apparently healthy plants of the same variety by inarching the stems of rooted cuttings.

Hibiscus

Yellow vein mosaic of okra or bandakka (*Hibiscus esculentus*) is common and exceedingly disastrous in the Matale district, the northern portion of the south central wet belt. Since the disease appeared a few years ago the yields have declined over 50%. The disease is transmitted by a white fly and a field study of its distribution early in the growing season suggested that the disease is harboured by weeds on the uncultivated land of the area. Although Capoor and Varma[3] found that in India the host range of this disease is confined to Malvaceae, no evidence is available in Ceylon of transmission to or from weeds belonging to this family. The characteristic symptom is the conspicuous yellow vein-banding of the foliage.

Solanaceous plants

Leaf curl of chilli (*Capsicum annuum*) is exceedingly common and causes great damage throughout Ceylon. A few years ago chilli was an important and profitable crop in the Jaffna Peninsula, but as this disease has reduced the yields by approximately 75% the growers are now abandoning the crop. The disease appears to be caused by a virus complex and mite injury. Two distinct mottles have been isolated from the complex by sap transfers. One mottle, proved to be caused by the tobacco mosaic virus, was probably introduced into the chilli by mechanical means, for where it was found the chilli was growing close to mosaic infected tobacco. However, sap transfer studies from the leaf curl complex have shown that tobacco mosaic in the complex is comparatively rare. The other mottle appears to be a common constituent of the leaf curl complex. This mottle is not so readily transmitted from chilli to chilli, as is the tobacco mosaic virus. Dr. H. E. Fernando has recently isolated a similar mottle-producing virus from the leaf curl complex by means of aphids. By means of the white fly he has also separated a virus from the complex that causes vein-clearing in chilli. The symptoms induced by this latter virus bear no resemblance to the two separated from the original complex by sap transfers. However, the aphid transmitted virus appears to be identical with the chilli virus that is transmitted with difficulty by sap transfers. The characteristic symptoms of the leaf curl disease of chilli are foliage vein-clearing and mottle followed by pronounced curling, leaf shape distortion, and size restriction.

Storey's leaf curl and mosaic of tobacco are widespread and disastrous in Ceylon in those areas where tobacco has been grown over a long period. Of the two diseases, leaf curl is by far the more important. The losses are particularly high in the variety Harrison's Special, which is unfortunate, since there is a strong demand for the leaf of this variety. A coarse leaf type often referred to as the Jaffna variety appears somewhat tolerant to both diseases. This tolerance is probably due to the long-established practice of the growers in the Jaffna Peninsula of selecting the most attractive plant each year for seed purposes. Although both diseases are widespread in the Jaffna Peninsula, a wind-swept area in the southern part was found to be free. The possibility of protecting newly-established tobacco areas from both diseases is extremely promising. On the Hingeragoda Station in the central part of Ceylon 150 acres of tobacco carried less than 0.1% infected plants at the time the leaf was harvested. Tobacco has been grown for only three years on this station.

Little leaf of brinjal or eggplant (*Solanum melongenum*) is widespread in the Jaffna Peninsula and elsewhere. The characteristic symptom is a marked reduction of leaf size, almost a witches' broom effect, in the upper part of the plants. Little information is available on this disease except that it is not sap-transmissible and that it seriously affects fruit yields.

Top leaf curl of tomatoes is prevalent in the wet south central mountainous regions. The disease is characterised by chlorosis, growth restriction, downward curling and twisting of the leaves. These symptoms first appear at the top of the plants. The disease has been transmitted by white fly, by inarching, and is not sap-transmissible. It appears to have an unusually long incubation period. Symptoms rarely appear in less than 20 days at 80°F. after inarching. In the vicinity of Peradeniya tomato plants are rarely free from the disease when they reach the fruiting stage. When the symptoms appear in plants less than a foot high little or no fruit is produced.

Banana

Among the well-known virus diseases of Ceylon, bunchy top of plantain (*Musa sapientum*) continues to cause substantial losses, although a compulsory eradication policy established a number of years ago did much to lower the incidence of the disease. Failure of many growers to search for and destroy diseased plants during the last two years has resulted in a considerable spread. Field evidence suggests that the spread of the disease is due principally to the planting of infected shoots rather than to transmission by aphids. Spread by aphids appears to be very limited.

Tea

The vector of phloem necrosis of tea remains unknown and the disease has not become a serious menace to the industry. It appears to be confined to high elevations and no records exist of the disease being found below 3,000 ft. In addition to this effect of altitude, the distribution pattern is difficult to explain. There is a tendency for the disease to spread to adjacent plants only, as though a soil organism were a vector.

Cucurbitaceous plants

Cucumber mosaic is by no means rare in cucumber, pumpkin or squash, but the disease is not general throughout Ceylon, and has not become a serious menace to the production of cucurbit fruit except in very limited locations.

Weeds

Few of the virus diseases of the weeds of Ceylon have been investigated. Conspicuous vein-banding diseases of *Stachytarpheta jamaicensis*, *Sida acuta* and *Ageratum conyzoides* are present in all areas where these common weeds are found. All three have been transmitted by inarching or grafting, but sap inoculations failed. A virus disease of *Synedrella nodiflora* characterised by leaf-cupping, chlorosis and a harshness of the foliage was also transmitted by inarching, but not by sap inoculations.

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(From *FAO Plant Protection Bulletin.*)

U.S. Agricultural Trade Mission Visit to Britain

A study group of 19 American agricultural experts visited London recently on the first leg of a 45-day tour of Western Europe to explore the possibilities of expanding trade in agricultural commodities, improving marketing and trade practices and promoting international trade through private channels.

These specialists largely from private industry have been asked to perform the study under the aegis of the U.S. Department of Agriculture, to implement one of the important steps in President Eisenhower's farm programme message to Congress on January 11, 1954. In that message the President called for 'a series of trade missions'—one to Europe, one to Asia and one to Latin America—to study 'the possibilities of expanding international trade in food and fibre.'

After consultations with the President, the Secretary of Agriculture, Mr. Ezra Taft Benson, and other government officials in Washington, the trade mission for Europe flew first to London and then to Paris where it divided into two groups—one to visit Northern European capitals, the other to travel through Southern Europe.

The mission stayed in London for five days, meeting with leaders in agriculture and trade in both private industry and government. The party was composed of 17 officials of private producer and marketing organisations in the United States—many of whom have held important government assignments, and two Department of Agriculture officials who will serve as secretaries of the groups visiting Northern and Eastern Europe.

Protection of Stored Grain with 'Pybuthrin' Insecticides

J. L. WARNER, B.Sc., D.A.Sc., M.I.Biol.
Cooper, McDougall and Robertson Ltd.

THERE are several ways in which stored grain and other food commodities may be protected from insect infestation. In general, the methods of protection may be divided into two groups: (*a*) control of infestation in the structure of the building, in containers, in transport vehicles, etc.; and (*b*) treatment of the commodity itself. It will normally be essential to apply both methods for the efficient protection of stored grain.

Before discussing the details it may be as well to define the word protection as opposed to control of infestation. By protection we mean suitable action taken to prevent or minimise infestation of *clean, uninfested* grain already in storage or to be stored in a warehouse, silo, farm granary and similar premises. It is well known that the infestation of clean grain may be caused through storing it in infested premises, or by cross-infestation, *i.e.* insects spreading from one infested commodity to an uninfested commodity, or from one infested building to another; also through the use of infested bags and other containers, and during transport. This article deals with the protection of clean, uninfested grain.

Control of infestation in the structure

The first condition for successful control of infestation is general hygiene of the premises. Indeed, more good can be done by cleaning without the application of chemical control than by chemical control *without prior* cleaning. Liquid preparations can control infestation on the surface of the fabric by direct sprays and give a prolonged residual deposit of insecticide which remains active for varying periods, depending on the type of insecticide used and other factors such as type of surface, temperature and light.

An additional value of liquid insecticides is that their application can be directed into situations where insects are likely to breed or seek shelter, and they can be efficiently sprayed on to surfaces over which insects may crawl. Furthermore, liquids can be conveniently used for spraying directly on to migrating larvae, so that no larvae are allowed to go deep into the fabric.

The premises where grain and other food commodities are stored are seldom completely empty, and the avoidance of risk of contamination with poisonous materials is important. Consequently treatment is best carried out when the store is more or less empty. Alternatively, sheets should be used to protect commodities from the risk of splashing and dropping of the insecticide on to the goods.

'Pybuthrin'

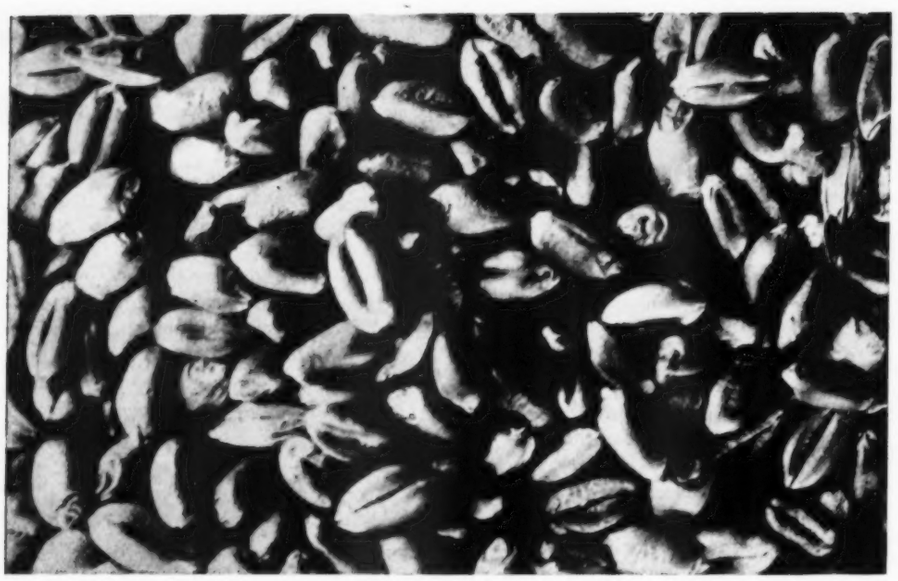
'Pybuthrin' is the registered trade name for a mixture of pyrethrins—the active principle of pyrethrum—and piperonyl butoxide. The addition of the synergist, piperonyl butoxide, to pyrethrins increases the lethal effect of the latter up to eight or more times, according to the species of insect, formulation, and method of application. In certain cases the stability of the mixture is also increased. It should be mentioned that 'Pybuthrin' insecticides, in addition to being non-hazardous to health, are non-tainting and less-staining than the biologically comparable pyrethrum formulations. They retain their insecticidal activity after application for longer periods and are *less costly* than the equivalent pyrethrum insecticides.

'Pybuthrin' is available in various formulations and can be applied by means of handsprayers, mechanical power sprayers, and mist or fog generators. In the latter field the latest development is the use of the 'Microsol' machine which is capable of producing not only a fine or a settling mist but also, when directed on to various surfaces, a satisfactory film of insecticide.

For use against stored grain insects, 'Pybuthrin' Insecticide No. 44 is specially recommended, having a biological efficiency equivalent approximately to 1.3% w/v pyrethrins spray. The general rate of application of this formulation is about 1 gal. per 2,000 sq. ft. as a direct spray, and about 1 gal. per 1,000 sq. ft. as residual film for prolonged action. All types of transport vehicles, sacks and bags used for the conveyance of grain can be similarly sprayed after a thorough cleaning.

Where the application of insecticidal dusts is more desirable, *e.g.* in cracks and crevices in the fabric or in other awkward situations, 'Pybuthrin' powders can be used without introducing toxic hazards. 'Pybuthrin' dust can also be used for laying a complete protective coating on the surface of the structure prior to storing uninfested grain. After a general clearance, followed by thorough cleaning of the premises carried out before taking in the new

Untreated wheat after 16 months of storage in a heavily infested store. Damage due mainly to *Calandra granaria L.*, the Grain weevil, and *Oryzaephilus surinamensis L.*, the Saw-toothed grain beetle. Recorded loss of weight, corrected for moisture content—6.2%; number of insect-damaged grains—16.5%



Wheat treated with 'Pybuthrin' Grain Protectant after the same period of storage alongside the untreated wheat. Recorded loss of weight—1.6% ; number of insect-damaged grains less than 1.3%

grain, 'Pybuthrin' powder should be applied to the structure. This application will consists of laying a fairly thick, even and continuous 'carpet' of the powder on the floor where bulk or bagged grain is to be stored. Similarly, in the case of small bins, tests have shown that several pounds of 'Pybuthrin' dust blown into an empty bin will give an even protective coating of the inner surface, in addition to clearing up the existing infestation of the bin.

Treatment of the commodity

The above-mentioned characteristics of 'Pybuthrin' insecticides make them particularly important and useful for treating grain and other commodities in storage. Owing to its relatively non-poisonous and non-tainting nature, 'Pybuthrin' Insecticide No. 44 can be applied as space sprays (mists or fogs) over grain stored in bags or in bulk, for the control of flying moths. It can also be sprayed directly on bagged, or even on unprotected, grain in bulk for the control of beetles, moths and their larvae. Thus, a protective film can be laid over the surface of the commodity which is lethal to insects crawling over it or to adult moths alighting to rest or lay their eggs.

Protective spraying of grain and other commodities is of special significance in the case of *Ephestia elutella*, the Cacao moth, one of the most serious pests of stored grain and many other food products in this country. Unless preventive measures are taken, it is almost certain that infestible commodities in store will become infested during the early summer, even if only a small number of larvae are present in the autumn. 'Pybuthrin' Insecticide No. 44 has all the characteristics required for protective spraying. It acts quickly, paralysing the female moth before the eggs are laid, and the kill is certain.

The protective film covers the whole surface lightly but completely, leaving no part unprotected. It is, therefore, important that whenever continuity is disturbed by breaking an existing stack, the newly exposed surfaces should be sprayed *on the same day*. It is necessary to repeat the spraying at regular intervals of, say, four to five weeks from early in May until late in October. The recommended rate of application is from ½ gal. up to 1 gal. for 1,000 sq. ft. In addition to surface treatment, space spraying against flying moths is effective and, when carried out at night, at daily to weekly intervals, tends to provide an insecticidal cover on parts of the surface which may have been missed in surface spraying. The rate of application of 'Pybuthrin' as air spray should be ¼ pint per 15,000 cu. ft. of space.

'Pybuthrin' dust

Another method of protection of bulk or bagged grain is the application of 'Pybuthrin' dust to the surface of commodity in store. The powder should be applied at the rate of about 4 to 6 oz. per sq. yd. The application can be by means of a shaker-box fitted with about six-mesh woven wire or by a powder blower. For the protection of bagged grain, protective spraying would probably be more effective and easier to carry out than the surface application of dust. The powder, on the other hand, may, under certain conditions, last for a longer period.

Grain Protectant

A recent development in the field of grain protection against insect infestation is the admixture of an insecticidal dust with clean, uninfested grain. This is already being practised on a large scale in the U.S.A., and a similar technique to suit the conditions in this country has now been devised. 'Pybuthrin' Grain Protectant consists of a stable formulation of 'Pybuthrin' in an organic carrier. It can safely be mixed with grain at the recommended rate, being free from toxic hazards, risk of tainting or effect on seed germination.

Successful treatment with 'Pybuthrin' Grain Protectant depends on adequate mixing with the grain and the best time to treat is after harvesting, before or as the grain comes into store. Grain in bins, etc., can be treated during intake or turning operations, but for smaller quantities and in small farm premises simple spade mixing or mixing in a manual seed dresser is adequate and convenient. The rate of application of 'Pybuthrin' Grain Protectant is 1 lb. to 600 lb. of grain, and if a careful admixture is achieved the disinfestation of the structure of the stowage in which the grain is to be stored becomes much less important. After stowing the treated grain, the surface should be covered with a light film of the protectant.

Conclusion

The results obtained from trials in this country with insect-free grain stored in heavily infested premises have shown that the protection obtained with 'Pybuthrin' Grain Protectant is good up to a year on the criteria of numbers of live insects, grain injury and weight loss in comparison with untreated grain stored alongside. Even after 16½ months the treated grain was found in better condition than the untreated grain. Protection is due to the repellent as well as the insecticidal property of the powder, which is effective against a wide range of grain pests including *Calandra granaria* (the Grain weevil) and *Oryzaephilus surinamensis* (the Saw-toothed grain beetle). The former is an important primary, and the latter an important secondary, pest of stored grain.

The protective methods outlined in this article may not always be 100% effective, but they do reduce considerably the risk of insect infestation without introducing toxic or other hazards. They can prevent serious losses of food by preserving harvested crops for human consumption and stock feeding.

South African Crop Prospects

WE have received from our correspondent in Cape Town the following information on agricultural developments in the Union of South Africa.

Railway fruit trees

Thousands of fruit trees planted alongside railway lines, supplemented by many trees which found a chance origin in fruit stones hurled out of train windows by passengers, have made the South African Railways Administration the owner of what is estimated to be South Africa's biggest orchard. Reporting this in its official journal, the Administration states that it has made great progress in making its stations beautiful.

A most attractive effect has been achieved by the planting of thousands of fruit trees along the line, with special maintenance gangs to tend them. The trees serve a twofold purpose, for besides brightening up the appearance of stations they provide shade for workers on a hot day and may even supply them with an occasional guava, peach or apricot.

In addition, fruit research stations have realised that the trees, planted as they are in widely separated parts of the country, may supply useful information about what varieties are best suited to different localities, and have consequently also started supplying trees. Reports on the progress of the trees are submitted periodically to the Railway Horticultural Department. The Horticultural Department has not stopped at the planting out of orchards. The laying out of gardens which feature rockeries, lawns, fishponds, and meandering streams crossed by footbridges is also part of the scheme to make stations beautiful. The latest developments may be seen at Johannesburg's new station.

Cultivation implement costs

In regard to farming costs the Division of Economics and Markets reports that the combined index for cultivation implements reached its post-war peak of 277 in October 1952. Last April it slipped down to 276, and last October to 275, the first quarterly declines for at least seven years and probably since the outbreak of war. The combined index for harvesting implements and miscellaneous implements—windmills, cream separators, hammermills and the like—also reached its post-war peak in October 1952, maintained it until last July, but dropped one point to 270 last October. Building materials (corrugated iron, cement, timber, etc.) dropped 36 points over this period.

Krugersdorp peaches

King Farouk used to pay £5 a tray for peaches flown to Cairo for him from a Krugersdorp orchard. Even now the popularity of Krugersdorp peaches has continued to expand in Cairo. Their grower, Dr. H. Swain, has proved in Cairo, Belgium and Britain alike that the Rand can produce export peaches and plums as fine as any in the world. From the Roodekrans Fruit Farm, near Witpoortje Falls, he sends fruit by air to all those countries as well as to West Africa, Kenya, the Belgian Congo and the Rhodesias. Lower air freights would improve the market. Most of the £5 a tray paid in Cairo was air freight. The secret of this success is hard thinking, hard work and attention to detail. He said too many fruit growers on the Rand ' handle their peach crop like potatoes.' His Bantu pickers are taught how to pick peaches at a much riper, sweeter and more easily bruised stage than the common Rand practice. From the time they are picked until his truck takes them away, carefully wrapped, in trays lined with wood-wool, no peach ever touches another. He employs up to 14 European women to grade and pack his crop. A scientist by training, Dr. Swain only recently became a farmer. He took two years to choose his land for fruit growing. It needed four assets—the right soil, the right climate, water for irrigation, and access to transport. In 1947 he found what he wanted—a north-facing hillside of sugarbush with the Witpoortje River close at hand and Krugersdorp not far away.

Since then he has planted 17,000 peach and plum trees in the deep, red soil, carefully selecting the right climatic zones down the long slope for each variety. At the bottom, with its hard frosts, he put the Marina peach, which needs a cold winter but flowers late enough to escape late frost. At the top, with its mild climate, he puts the King Edward peach, a so-called ' subtropical ' fruit.

Maize exports

A windfall of several million pounds is expected to accrue to South African maize farmers as a result of the Government having given permission to them to export some of the maize which is surplus to the country's requirements. Negotiations for export are proceeding by way of tender. The world price is about 10s. a bag higher than the local price, which is 32s. a bag to the grower. Competent authorities think that it will be possible for the Government to permit the export of not less than 5 million bags. The quantity which the Union can safely spare may even be as high as 15 million bags. Current annual requirements in the Union are estimated at 26 million bags, and the Government like to have a carry-over of about 5 million bags in case the crop is poor the succeeding year. With a crop of 33 million bags last year and a crop already estimated unofficially at 40 million bags this year, there would thus be an expected surplus over annual requirements and normal reserves of about 15 million bags.

Vine varieties

New kinds of vine are being bred near Pretoria in an effort to provide the Transvaal with cheaper grapes. So long as grapes have to be railed from the Cape Western Province, 1,000 miles away, they will remain a luxury fruit in the Transvaal because of their cost. The main drawback of the Transvaal is that its summers are wet. The first step towards the vine-breeding programme has already been taken. Mr. W. Carstens has planted 70 varieties of vine in the past three years at the Division of Horticulture's research station on the Pienaar's River to see which offer most promise in themselves or for crossing.

Sugar production

Returns issued by the sugar industry show that for the season up to November 28, 1953 the mills crushed 5,209,901 tons of cane from which 621,653 tons of sugar were manufactured. During a corresponding period of the 1952-53 season 588,116 tons of sugar were obtained from 4,940,770 tons of cane, and a comparison of the operations of the two seasons shows that the 1953-54 cane crop reflects considerable improvement over that for the 1952-53 season, both in the weight of the yield and in sucrose content. Several mills have completed their crushing for the season, and it is expected that the total output of sugar will amount to about 725,000 tons, compared with last season's total of 670,188 tons and the industry's former record of 685,798 tons of 2,000 lb.

In view of the expansion in production, the export of 95,000 short tons has been authorised and it is interesting to note that exports of sugar during the first 11 months of 1953 were valued at £1,728,865, compared with only £256,852 for the same period of 1952. Growers have been busy recently in clearing land from which the last cane crop was obtained.

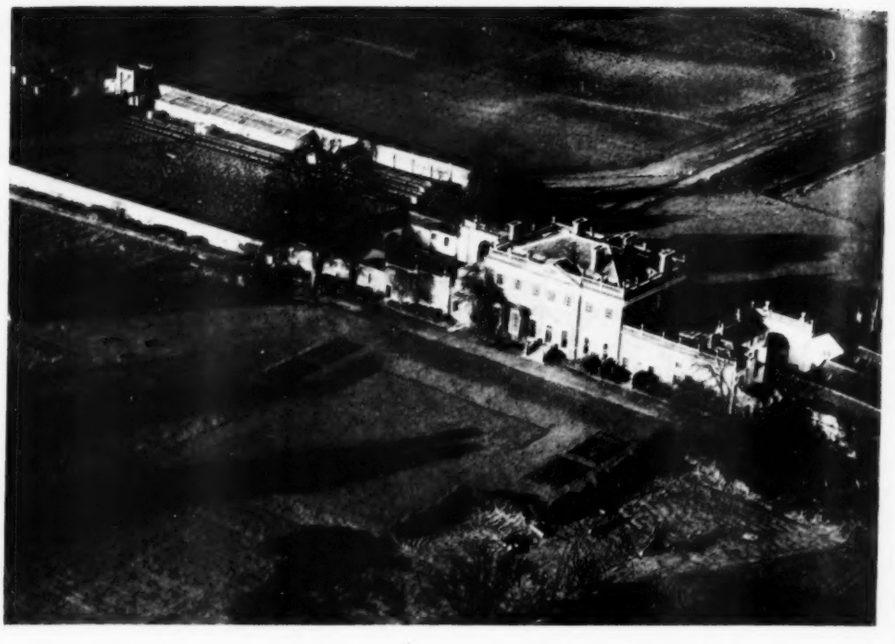
The Ford Mechanised Farming Centre

A recent development announced by the Ford Motor Co. Ltd. is the opening of a mechanised farming centre at Boreham House, near Chelmsford. Boreham House itself originally formed part of the estates of the Duke of Albemarle. They were later sold to Sir John Tyrell and in 1930 Lord Kenyon sold them to the Fordson estates. They were subsequently used in a variety of ways, *e.g.* training for the Women's Land Army, and they were purchased in 1953 by the Ford Motor Co. The object of the Ford mechanised farming centre is to provide short courses for personnel and dealers attached to the Ford company and also tractor owners and trainees for Government and other agricultural extension organisations. The courses are from five to 10 days' duration and include instruction both in the theory and practice of servicing and maintenance of tractors and agricultural machinery.

The opening

The centre was opened officially by Major-General Sir Harold Wernher in the presence of a large and distinguished company of guests on Tuesday, May 4. In requesting Sir Harold to perform the opening ceremony, Sir Patrick Hennessy, vice-chairman of the Ford Motor Company outlined the object of the centre and the type of instruction that would be given. The centre was then opened by Sir Harold Wernher and subsequently the guests were given the opportunity of inspecting the facilities provided for courses of instruction and the excellent residential accommodation for students.

All present were impressed with the facilities offered; equipment includes a complete range of machinery for use with the Fordson Tractor and 70 acres of arable farm land. The Principal of the centre is Mr. E. B. Black, B.Sc., and the Director of Studies is Mr. E. J. Bullock. The Agricultural Adviser to the Ford Motor Company is Mr. S. J. Wright, M.A.



(*Above*) **An aerial view of Boreham House, and part of the estate.** (*Below*) **A demonstration in progress**

Pakistani Visit to the Sudan Gezira Scheme

Three Pakistani officials of the Thal Development Board recently spent a month in the Sudan, visiting the Gezira Scheme, under arrangements made for them by the British Government under the Colombo Plan Technical Co-operation Scheme.

The Thal Development Project is one of the major schemes which has been undertaken by H.M. Government, and also by the other Commonwealth Governments. More than 600,000 acres of waste land in the Thal are being irrigated and developed to provide homes and farms for Pakistanis who left India after partition of the subcontinent. The Pakistan Government wished to send a team of officers working in the Thal Scheme to study methods of development adopted on similar projects in other parts of the world. H.M. Government offered, under the Technical Co-operation Scheme of the Colombo Plan, to arrange with the Sudan Government for a team of three Pakistani officials to visit the Gezira Scheme from mid-April to mid-May.

The three officers were Mr. Mohammed Saied-ud-Din, Sardar Muhammad Gill and Mr. Wali Mohammed.

Mr. Mohammed Saied-ud-Din is Director of the Agricultural Machinery Organisation for Thal Development Authority. His organisation maintains a large fleet of tractors and other earth-moving machinery, ploughs and other agricultural machinery, and has its own workshops.

Sardar Muhammad Gill is Agricultural Officer to the Thal Development Authority, supervising the working of 10 farms and 19 fruit-gardens with a total area of 30,000 acres. Mr. Wali Mohammed is an Executive Engineer in the Irrigation Branch of the Punjab Public Works Department. He is in charge of the construction of new irrigation canals in the Thal Development Project.

RESEARCH DEVELOPMENTS

Fertilisers and Plant Nutrients

Nitrophosphate processes

A useful survey of nitrophosphate processes and others that save sulphuric acid has been issued by O.E.E.C.[1] Whether the sulphur position that originally prompted the survey is now as urgent and serious may be doubted, but the compact description of all the nitrophosphate variations is valuable. The F.A.S. and Dutch State Mines processes, the French Onia and the Norsk Hydro processes, the Swiss Lonza Usines process, and the mixed nitric-sulphuric processes are all covered. Dicalcium phosphate processes (using HCl) are briefly described. Economic data are provided more fully than technical details, a welcome change of emphasis.

A fully detailed paper on the new TVA process has now appeared.[2] Additional information includes these facts: 42% nitric acid is used in a three-stage successive tank acidulation; it is believed that for full-scale sized plant a two-stage acidulation will be just as effective. The phosphate rock is ground to less than 35-mesh. The acid/P_2O_5 ratio is such that a molar ratio of HNO_3/CaO is held at about 1.8. The use of sodium salts to minimise phosphate reversion in ammoniation is utilised in the TVA process; indeed, without it the process would not have been economically competitive with other nitrophosphate processes. Sulphates of Na, K, NH_4 and Ca have all been found equivalently effective in reducing reversion, but chlorides and $NaNO_3$ are reported as being ' of little or no value,' a verdict that conflicts with that of other studies. The reason why sulphates are especially effective is unknown and the need for further research is mentioned.

The I.C.I. process has been more fully described than hitherto by D'Leny.[3] As is well known, this process relies upon both ammonia and ammonium sulphate to remove the calcium nitrate formed. It is revealed that I.C.I., in contrast to many other nitrophosphate ventures, use rather less than the calculated amount of HNO_3 in treating phosphate rock; 50% acid is used. Ammoniation must take place before the acid solution hardens through formation of calcium nitrate tetrahydrate. Any delay involves a serious loss of fluidity. Roughly, about half the calcium nitrate present is decomposed by ammonia, the Ca released being taken up by $Ca(H_2PO_4)_2$ to form $CaHPO_4$. Though production costs per ton of product would be higher, this is offset by the higher NPK content attainable. The P_2O_5 in this type of nitrophosphate has a little under a third in water-soluble form, the rest being citric-soluble. Economic success would seem to depend upon the recognition of citric-soluble P_2O_5 so that it may be sold for as much or nearly as much as water-soluble P_2O_5. The pilot plant has produced several hundred tons and a number of field trials have thus been made possible. These are reported. For potatoes and swedes in 1952 the responses to nitrophosphate and superphosphate for equivalent nutrient supplies were closely similar. Additional points made in the paper are that the total reaction time is only 10 min., that the granular product is free-flowing without a curing treatment, and that no HF difficulties have been observed during pilot-plant operation.

A third paper of importance on this subject is an economic survey of nitrophosphate processes.[4] It is concluded that under *current* market conditions output must exceed 50,000 tons of NPK product before this means of utilising rock phosphate can compare favourably with the conventional sulphuric acid method; also, that for still larger tonnages per annum the extent of advantage would be enhanced. Greater costs for sulphuric acid from non-sulphur sources or as a result of increasing costs for elementary sulphur will increase the economic prospects of the nitrophosphate method.

Superphosphate ammoniation

Any assessment of nitrophosphate prospects must also include the possibility that costs in the more conventional method of NPK fertiliser production can be reduced; in this connection the introduction of N by ammoniating superphosphate is far from irrelevant, for it (*a*) reduces the cost of N per unit, (*b*) enables higher-analysis compounds to be produced. This development is hamstrung in Britain by existing legislation which accentuates the importance of water-soluble P_2O_5 and by non-recognition prejudices the valuation of citric- or citric-soluble P_2O_5.

Uptake of nutrients

Water culture experiments with sugar cane have provided results that seem difficult to interpret.[5] Phosphate was presented in four different forms—potassium and sodium phosphates, and calcium and magnesium monophosphates. Nitrogen was supplied as ammonium sulphate or ammonium nitrate. It was found that the rate of phosphate absorption was greater when the nitrogen was being supplied from ammonium nitrate; and also that the rate of phosphate uptake was greater in this order: Mg monophosphate — calcium monophosphate—potassium phosphate—sodium phosphate. Older field work has sometimes indicated that phosphatic fertiliser efficiency is improved by the presence of Mg (*e.g.*, the wartime development of serpentine as a superphosphate ' synergist ' in New Zealand). It would seem desirable for experiments of this type to be carried out with other crops to see if similar results are obtained.

Potash progress

Information about the development of British potash deposits lying at 4,000 ft. depth in Yorkshire has been sparse. The help of a well-known mining organisation has been sought,[6] which suggests that hope of raising the potash by brine-pumping methods has decreased. A somewhat indirect source of information suggests that a huge capital outlay will be necessary, greater than is likely to be applied by industry and also unlikely to be provided by the Government.[7] But in Saskatchewan, Canada, an arrangement has just been concluded with an American potash company to spend a large sum in 1954-56 on exploring the possibilities of mining the 3,000 ft. deep deposits at Saskatoon.[8]

A joint Norwegian-Dutch project to manufacture potash fertilisers from sea water is reported.[9]

A long-term study of potassium fixation and leaching loss has been published.[10] It clearly shows that annual and moderate K applications suffer less fixation loss than heavy and intermittent K applications; the parallel findings of modern phosphate research will be appreciated.

The importance of K for lucerne is emphasised in a paper[11] reporting 1950-52 field trials on soils low in potash. The most profitable rates of dressing were as high as 4½ to 5 cwt. of 60% muriate per acre. Failure to supply K in the earlier years of lucerne establishment leads to poor yields and severe weed competition.

Bacterial fertilisers

Post-war Russian studies of bacterial inoculations that increase the availability of soil reserves of P and K have been surveyed by Chester.[12] Earlier attempts to develop this approach (1908-1920) are recalled. Several types of inoculations have been developed in the U.S.S.R., and in 1952 trials were conducted on more than 1,000 farms. P-solubilising bacteria, possibly based upon *Megatherium viphosphat-*

ium, are claimed to have increased test crop weights from 218% to 1,127% with similar increases in P uptake from normally unavailable P. Silicate bacteria, based on a new species, *Bacillus siliceus*, break up alumino-silicates and release locked-up K; this type of inoculation is said to have raised cotton yields by 8% to 24%. It is important to note that the successes of bacterial fertilisers have been much more marked on highly organic soils (the chernozems) than on non-chernozem soils. A factory at Kiev is said to be producing bacterial fertilisers at maximum capacity and the U.S.S.R. Ministry of Agriculture has ordered mass production and an intensification of field testing.

Abbreviated from a report in our sister journal 'Manufacturing Chemist.'

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East-West Agricultural Trade

A resolution stressing the need for increasing agricultural trade between East and West Europe has been unanimously adopted at a meeting of the United Nations Economic Commission for Europe. Jointly sponsored by the Soviet Union and Denmark, the resolution decided that the agriculture committee, which has not met since March 1950 be reconvened this year. The agriculture committee was asked to:

1. Examine the short term and probably medium term supply and consumption trends in agricultural and food products concerning European producers.

2. Facilitate any work carried out within the framework of the trade development committee.

3. Provide a channel for the exchange of technical information and experience on agriculture.

Many delegates from both East and West Europe emphasised the importance of working out a practical programme of work for all-European co-operation in this field. They suggested that standardisation of spare parts for farm machinery, reorganisation of quality standards and the furnishing of market surveys should be among subjects for early discussion. All delegations pledged full support for the committee.

Inter-African Soils Conference

From August 9 to 15, 1954, an Inter-African Soils Conference will be held at Leopoldville (Belgian Congo). This intergovernmental meeting—a demonstration of technical co-operation in Africa south of the Sahara—is organised under the auspices of the C.C.T.A., with the material assistance of the Belgian Government, the inviting power. Every country being a member of the C.C.T.A. will send delegates, up to a total of 80 specialists in agronomy, soil science and conservation. Invitations have also been sent to organisations likely to be interested in the conference.

The objective of the conference is:

(1) To review the work accomplished following the recommendations of the Goma Conference.

(2) To make a statement on progress in soil conservation in Africa.

(3) To adopt rules for the classification, analysis and study of African soils.

(4) To further the study of certain almost unknown subjects of particular interest in the conservation and utilisation of African soils.

(5) To determine the broad lines of further work to be carried out within the framework of African co-operation.

The date and place of the meeting have been chosen with a view to allow the participants to attend the 5th International Congress of Soil Science, which will take place in the same town immediately after the Inter-African Soils Conference has ended.

At the end of the session of both the conference and the congress excursions will be organised by the Belgian Government.

The B.I.S. (Inter-African Bureau for Soils), 57 rue Cuvier, Paris Vème, has been charged with organising the Technical Secretariat of the conference; to it requests for further information about this meeting should be addressed.

Tushing Thinnings

Although draught horses have been ousted from most of their former forestry jobs by tractors, they still retain their old utility for the important work of tushing thinnings to main loading points. The hire for a horse for such work may vary, according to circumstances, anywhere from 15s. to 30s. a day. As the area of plantations which require thinning about once every three years (fast-growing conifers in the 20 to 40 years age groups) is expanding every year, this use of horses is worth noting.

How long will it be before a mechanical device is invented capable of coping with the special circumstances, which include very rough and steep ground, from where the tree is felled to the ride down which the poles are tushed to the loading point?

Tushing thinnings from a larch plantation

NEW BOOKS

The Limits of the Earth

By Fairfield Osborn. Pp. 175. 1954. London. Faber and Faber. Price 12s. 6d.

The problem of the limits set by nature on the ability of man to reproduce himself and to maintain his existence on the surface of a world of finite dimensions is one which of late years has occupied the attention of scientists, statesmen and philosophers to an increasing degree. Beginning with Malthus at the opening of the 19th century, the problem has claimed more and more the consideration of thinking men and women in all civilised parts of the globe.

From time to time new discoveries, both geographical and in the domain of increased production, have led enthusiasts to proclaim that the ghost of Malthus has been laid for good, only to see this indomitable spectre once more raise its head, as time goes by and the population of the world gives one more astounding proof of its limitless capacity to reproduce itself and to outstrip the supplies of food available for its sustenance.

Scholars and scientists have contributed books, pamphlets and papers dealing with the problem, learned societies, congresses and conventions have discussed it and specialist aspects of various matters connected with it, statesmen and divines have added their contribution, without, it must be confessed, bringing the world appreciably nearer to the desired solution, although it must be added, few today are found who will deny the reality of the threat or aim by facile assumptions to deaden man's apprehension of its urgency.

Among the spate of literature devoted to the question, this book by Mr. Fairfield Osborn must be accorded an honourable place as a serious and courageous attempt to define the position and to assess the possibilities of increased agricultural production to meet the ever-growing wants of an expanding world population. In an earlier book entitled *Our Plundered Planet* Mr. Osborn surveyed in lucid fashion the manner in which the natural resources of the world are being wasted in prodigal disregard of the future. In this work he surveys the world's resources continent by continent in an attempt to assess the extent to which each continental area is capable of being developed to supply the additional food and other natural products necessary for the continued existence of the human race.

In particular he pays special attention to the less densely populated regions of the world, such as South America, Africa and Australia, for example, which by many are held to contain the potential germ of large-scale future production to meet increasing needs. While admitting the possibilities of expansion in some of these, Mr. Osborn is careful to point out the limitations; thus, referring to Australia, he emphasises the severe limitations imposed by climatic conditions. In relation to the vast undeveloped and almost unoccupied regions of Amazonia in Brazil, he stresses the difficulties inherent in the natural conditions and points out how economic growth is being thwarted by existing political and economic conditions, and by ignorance of how to cope with the conditions of soil and vegetation which the natural climate of the region creates.

In a similar relationship he shows how in Argentina, one of the naturally most fertile regions of the earth, production is falling instead of rising, as it should do, largely owing to a Government policy in which agricultural production is sacrificed on the altar of political expediency, in order to carry out a programme of industrialisation and self-sufficiency, while the profits derived form a Government purchasing monopoly of agricultural products are being used to implement popular and vote-catching welfare measures.

In regard to Africa, the author shows a well-balanced appreciation of the problems and conditions which govern production in that vast region; while admitting the possibilities of greatly increased production in some areas, he is at pains to point out that the first result must be to increase available supplies for the consumption of the African populations themselves, and that readiness to grant the African an ample proportion of whatever progress is made in his own country is the only attitude that can lead to orderly development of the region.

South Africa is treated separately as an example of a country where historical happenings have served to create a community which is largely subservient to traditional values, many of which are based on error. He concludes the chapter dealing with this region by stating that it vividly refutes the statement, so frequently made, that the world problem of food supply can be readily resolved if present technical agricultural knowledge is put into practice, inasmuch as progress there is blocked by cultural and social barriers.

In two striking concluding chapters he summarises some of the potentialities, limitations and dangers. He refers to the present welter of conflicting opinions and concludes that it will be time to conjecture how many people the world can hold when the increase in production of vital resources is demonstrably keeping pace with population growth, but stresses the essential need for more extensive adoption of competent agricultural methods as well as the need for redressing inequitable and inefficient land tenure systems which prevail in many countries.

The book is a model of concise and clear writing. It is, indeed, surprising how much careful thought and skilful appraisement has been crammed into the 153 pages of text which the book contains. In the reviewer's view it is definitely a must for all interested in world problems of population growth and food supplies.

H.T.

The World's Food

By M. K. Bennet. Harper and Bros. New York. 1954.

The author of this fascinating book is the director of the Food Research Unit of Stanford University. The first three chapters are derived from a series of lectures and in many respects stand apart from the rest of the book. This early section is essentially a broad survey of the social history of the world, particularly from A.D. 1000 to the present day. This section contains an account of the development of world populations in which the author makes careful distinction, characteristic of the book, between fact, theory and reasoned fancy. It is shown quite convincingly that over the period of rise in the world population from 900×10^6 in 1800 to $2{,}400 \times 10^6$ in 1949, ' . . . consumption trends had risen over a large fraction of the population, that calorie consumption *per capita* cannot have fallen, that, again over a large fraction of the population, diets had become more diversified in composition, that famine from natural causes had fallen from its status as a nearly universal risk to a status of risk to a much diminished fraction of the swollen population of today.' This state of affairs is contrasted with Malthus' predictions and the differences between prediction and the fact are carefully analysed.

The second part of the book is concerned with an analysis of characteristics of the American diet. This is of very wide interest for although it is often dangerous to generalise from the United States to other countries, intensively collected data of the sort analysed here provide the only possible sources of solidly based working hypotheses to explain world food trends.

To the non-economist, the chapters concerned with ' Variations in consumption by season, region and income ' and ' Historical changes in the national diet '

make very stimulating reading. It is interesting, for example, to find comparisons between food consumption of major U.S. cities and to find that vitamin intake differs markedly between the populations of these cities. These differences are shown to be partly associated with differences in income but mainly with cultural practices and customs. These chapters also contain interesting graphs showing the major food products divided into groups according to how their consumption varies with income groups.

The third section of the book is concerned with 'The International Scene' and here the author examines the much less reliable and sparse statistics of food consumption for other parts of the world. It is in this section that many of the author's most striking comments are found —and where most disagreement is likely to be provoked. The chapter 'World Geography of Hunger' is largely a challenge to Boyd-Orr's 'A lifetime of malnutrition and actual hunger is the lot of at least two-thirds of mankind.'

This book should have an appeal to many who are not economists—though it is of course from the economists that detailed criticism must come. For agricultural scientists and agronomists the treatment of material makes a special appeal —the style is clear, the diagrams and graphs are quickly grasped and, most important, the subject matter is part of the cultural background of all who have to do with food at any stage of production and distribution.

To the scientist there is an added attraction in following the form of argument and type of analysis used for problems which by their nature defy controlled experimentation and demand subjective appraisal. In such cases probability theory cannot guard the conclusions and significance is expressed as opinions of finely graded shades.

The book is well indexed and the immense scope of the book is perhaps best indicated by a direct quotation from the index, 'Millets, John Milton, Mineral Elements, Mongols, Moral Restraint, Mothers Milk, Murrain, Mutual Security Administration.'

J. L. HARPER

Insecticides and Colonial Agricultural Development

Edited by T. Wallace and J. T. Martin. Pp. x + 169, illustrated. Butterworths. 1954. 30s.

This volume contains the collected papers and reports of the discussions at the Sixth Symposium of the Colston Research Society held at the University of Bristol in 1953. A report of this symposium appeared in the June 1953 issue of WORLD CROPS. The meeting itself was productive of a number of noteworthy papers and much valuable discussion and it is a great advantage that this material should be presented in permanent form. The book contains some 16 different papers dealing with the control of insect pests and the use of insecticides in the British Colonial Territories which now comprise some 38 dependencies covering 2½ million sq. miles widely scattered throughout the tropics. Agriculture is the mainstay of existence in all of them and provides not only food for the populations but many crops for export.

The symposium represented an attempt to review the losses of crops caused by insect pests in the Colonies. Papers covered a wide range of problems while the discussions were particularly valuable since the conference was attended by many scientists who have been or are working in the Colonial Territories. The book itself is beautifully presented and contains a number of illustrations both in the form of photographs and line drawings. It should enjoy a wide circulation in the tropics and should find a place in the libraries of all Colonial Agricultural Departments and Agricultural Research Stations.

North American International Farm Meeting

The leaders of farm organisations in Canada, Mexico, and United States have agreed there is need for more effective co-operation at the producer and trade level within North America. Thirty farm leaders from the three countries conferred in Washington for the first time under the auspices of the International Federation of Agricultural Producers, February 23-24. They decided to hold periodic meetings in the future to reach a better understanding of farm production and trade problems in North America.

The meeting recognised that important problems exist in the countries concerned and that most of these are of mutual interest. It was agreed that Canada and United States have specific government programmes for dealing with these problems but that these programmes differ greatly in the means of implementation and a more effective way of dealing co-operatively with these common problems is greatly needed. The future periodic meetings which are to take place seek objectives similar to those of recently established joint Canada-United States economic commission at the Cabinet level.

The session devoted considerable time to a study of the respective policies of the Canadian and American Governments on price support, the marketing of agricultural commodities, and the disposal of present surpluses. Mr. H. H. Hannam, Mr. William Parker, Mr. J. H. Wesson, and Mr. H. L. Griffin gave detailed explanations of the operation of the Canadian Wheat Board and other facets of Canadian agriculture. The United States delegation explained the economic position of American agricultural markets nationally and internationally.

The current problem of a lack of an international agreement between the United States and Mexico on the entry of Mexican seasonal agricultural workers into the United States was considered by the meeting. It was unanimously agreed by the United States farm organisations present and the Mexican farm organisation that this question should be handled through an international agreement. They hoped the two governments would be able in the near future to come to agreement on the matter. The United States and Mexican farm bodies agreed to work to facilitate an agreement by their governments.

A portrait of modern Mexican agriculture was given by Alberto Salinas Ramos, the chief Mexican delegate. Considerable advance has been made in land reform in Mexico, he said, and an effective system of guaranteed prices for farm products has been introduced. The Mexican delegate said credit for agriculture has been improved with a greater volume of loans from official agricultural credit banks and from regulations which authorise private banks to operate with more liberal credits for equipment and production.

The North American farm organisations reached the conclusion that at least for the time being it would be best to hold informal periodic meetings which would provide a forum to discuss any mutual problems. They were unanimous in expressing the wish that IFAP, in consultation with its member organisations in North America, should at intervals organise and convene regional meetings for the discussion of mutual problems, including an examination in some detail of specific commodity and trade situations.

In closing the meeting, Mr. A. B. Kline, president of IFAP, said: 'This session has contributed to the general objective of IFAP of trying to get together and understand the problems of others and trying jointly to work out solutions to these problems. We are confident that these meetings can make a very great contribution to mutually advantageous trade and to prosperity among the nations.'

FARM MACHINERY

Ford Diesel Engine

A new diesel engine is now in production at Ford Works, Dagenham. It has been designed as an alternative to the petrol engine for the 2- and 3-ton range of Thames commercial vehicles. It is of 3.61 litres capacity, four-cylinder, developing 60 b.h.p. at a governed speed of 2,400 r.p.m. Ford production methods and design are stated to have made it possible to provide this engine at a basic price which is only £85 extra in the case of the 2-ton models, and £100 extra for the 3-ton models. The engine in both cases is identical, but servo assisted brakes with exhauster equipment are standard on the 3-ton vehicles.

The engine has been designed specifically to transport 2- and 3-ton loads in the most efficient and economical manner. Direct injection, a sturdy five-bearing crankshaft and wet cylinder liners are some of the design features contributing towards long engine life. Operating costs are reduced to a minimum because the diesel engine gives more miles to the gallon and the cost of fuel per gallon is less than that of petrol.

Developing 150 lb./ft. torque at 1,600 r.p.m. with over 140 lb./ft. between 880 and 2,200 r.p.m., excellent top gear performance is assured. Thus the use of intermediate gears is minimised and good average speeds can be maintained.

Ease of maintenance and accessibility have been carefully studied in the design. The layout of the engine compartment and the alligator type bonnet make all items of the fuel and oil systems, rockers, dipstick and butterfly adjusters readily accessible.

Seed Grader

The Fritz Döring Company, makers of 'Stahl Neusaat' seed graders, are at present producing a special machine, the 'Stahl Neusaat' 20, with 1,000 kilos hourly capacity with a second equipped cylinder. It is stated that this machine can clean and sort mixed grain in one working process only.

10-Gallon Power Sprayer

A new 10-gal. power sprayer, called the 'Suburban,' designed especially for the home user, has been announced by the H. D. Hudson Manufacturing Co., Chicago. According to the company, the 'Suburban' will do all spraying jobs about the home, such as spraying trees, shrubs, flowers, gardens. When equipped with a special four-nozzle boom, it can be used to spray lawns. It is stated to handle all spray solutions at continuous pressure. Pump capacity is 1½ gal. per minute. A mechanical agitator keeps sediment-bearing solutions such as whitewash well mixed during operation.

Only 21 in. wide and mounted on cushion-tyred wheels, and with adjustable handles, the 'Suburban' is easy to push or pull. Other features include a double-acting pump, welded galvanised steel tank, over-size opening in top for easy filling and cleaning, 10 ft. of hose, and an all-purpose nozzle that adjusts to any spray from a fog to a long-range stream. For maintenance, the pump can be easily removed. It is equipped with a 1 h.p. gas engine. An electric-powered model is also available.

The 'Suburban' sprayer which is now being produced

The Ames 'Roto-Rain' sprinkler system used to irrigate pasture

Ball Coupler for Irrigation Pipe

The time and effort required to couple and uncouple individual lengths of irrigation pipe have always been important problems for the irrigator. As an answer to these problems, the W. R. Ames Co. of San Franciso has developed the new Ames ball coupler which is stated to simplify greatly the setting up and moving of all types of portable irrigation lines.

Using the ABC coupler, a rapid positive connection is completed by merely inserting the 'ball' shaped end of one pipe into the 'bell' shaped end of the adjoining pipe. No twisting, latching or hooking is required. The slightest water pressure within the line automatically locks and seals the connection. There are no outside obstructions such as latches, pins or other mechanical devices to wear, come loose or be damaged in moving and storing. When the pressure is off, only a slight twist and a pull are required to separate the pipe sections.

Two active parts form the heart of the ABC coupler: a strong, flexible coil spring

The newly introduced 'Caterpillar' D.W.15 tractor

and a durable rubber gasket. Both are free-moving inside the bell-shaped end. As the ' ball ' end enters the ' bell ' end, it slips past the spring and gasket. As little as 1 lb. of water pressure in the pipe moves the gasket and spring forward, with the spring coming to rest against the lip at the outer end of the ' bell.' The gasket expands against the inner wall of the ' bell ' and the outer wall of the ' ball,' forming a watertight seal. The spring is held between the lip of the outer ' bell ' and the curvature of the inner ' ball,' providing a positive mechanical lock. Connections remain virtually watertight at all operating pressures.

The Ames Company is now using this new coupler on practically all of its portable irrigation pipe, including ' Roto-Rain ' revolving sprinkler systems, ' Perf-O-Rain ' perforated sprinkling pipe and gated surface pipe, used for furrow watering of row crops.

Along with the ABC coupler a new valve has been developed to provide instant precision control of water in main lines or from the main lines into laterals. The ABC valve can be instantly inserted anywhere along the line. Opening into its own body rather than the main line stream, the valve eliminates fluttering and chattering. The complete assembly is contained in a lightweight pressed-steel body, designed for convenient, trouble-free field handling.

New Caterpillar Tractor

A new 150 h.p. four-wheel tractor has been produced by Caterpillar Tractor Co. The tractor, the ' DW15,' is powered by a Cat six-cylinder D326 diesel engine, producing 150 h.p. at 1,800 r.p.m. with 5⅛ in. by 6 in. bore and stroke. The engine features aluminium alloy pistons with cast in iron band backing for the top compression ring. Chrome-nickel steel heat plugs incorporated into the pistons give longer life. A triple duty oil pump provides positive lubrication on steep grades. Oil can be picked up from the front or rear of the oil pan or from the main oil sump located near the centre of the tractor.

Standard transmission gives double speed ranges, with ten forward speeds up to 24 miles per hour and two reverse speeds up to 3.3 m.p.h. Optional final drive gears make possible speeds up to 31.3 m.p.h.

Large capacity wheel brakes are foot pedal controlled and have compressed air boosters. When brakes are applied, those on the pulled unit are actuated automatically just before the prime mover brakes take hold. The flywheel clutch has as air booster which reduces clutch pedal pressure when engaging and disengaging the dual 16-in. metallic clutch plates. A large 75-gal. fuel tank contains enough fuel for a full day of operation. Wheelbase dimension on the DW15 is 121½ in. Front tyre sizes are 12 by 20, 14-ply traction type; rear tyres are 21 by 25, 20-ply rock type.

This new portable tank for agricultural and dairy use is described on this page

All-Purpose Portable Tank

A novel portable tank, now being manufactured by the Booth-Robinson Engineering Co. Ltd., of 373 Essex Road, London, N.1, appears to fill a long-felt want in the agricultural and dairying fields.

The frame is made of angle iron and welded throughout. These frames, and the tanks, are manufactured in various sizes. The tanks are made from steel plate, which eliminates whip, and, to prevent any splashing, the top edges are of tubular steel. Special features of the tank are that the liquid container is removable at any time and that one stand only is required to support troughs of varying depth or shape.

The illustration shows the detachable rack on the side of the tank. The makers can also supply the ' Borobin ' portable tank fitted with three wheels to facilitate movement over hard surfaces — these wheels can be raised when not required. The whole unit is heavily galvanised to prevent rust and plug and chain are fitted as standard.

Technical News

In the June issue of **Fibres (Natural and Synthetic)** C. Earland writes on the ' Practical Aspects of Shrinkproofing Wool ', while ' "Ardil" Fibre from Groundnuts ' is described by John Grindrod. Other articles in this issue include ' The Requirements of Dyeing and Finishing Chemicals for Use with Cellulose Acetate Fibre ' and ' Calcium Alginate Fibres '—Data Sheet, by Prof. Paul-August Koch.

The June issue of **Paint Manufacture** includes ' Stirrer Efficiency ' by Prof. K. Magnusson, and ' Carbon Black for Surface Coatings ' by L. J. Venuto, while D. S. Ford writes on ' The Colloid Mill for Emulsion Paints '. There are also articles on ' Paint for High Moisture Conditions ' and ' Emulsion Paint Systems '.

Manufacturing Chemist for June contains ' Ointment Bases—1 ' by B. K. Martin, and ' Benzyl Alcohol ' by F. Schmitt, while C. A. Finch writes on 'Adrenocorical Hormones—3 '.

The June issue of **Corrosion Technology** includes ' Cathodic Protection—2 ' by L. L. Shreir; ' Paint versus Corrosion ' by H. Diamond; and ' Prevention of Corrosion by Water ' by P. Sherwood.

WORLD CROP REPORTS

WORLD

Wheat prospects. The 1953-54 world wheat crop, estimated at 7,045 million bushels, was second only to last year's crop, and 17% and 21% above the pre-war and post-war averages. Production in each of the major exporting countries is somewhat below 1952, but quantities available for export are high, especially in the United States and Canada. Both countries had large crops in 1953 and carry-overs from the preceding season were substantial. Of equal significance is the fact that large crops were harvested in most of the major importing areas, particularly Western Europe, thus reducing the usual import requirements.

In North America, the largest surplus-producing area, the 1953 crop is down 10% from the 1952 record. The Canadian crop, however, is second only to last year's record harvest and the United States crop is the fourth highest of record. The South American crop is expected to be about 315 million, which is above average, but somewhat below the large outturn last year. Argentina's crop is forecast at 225 million bushels, about 20% below the large crop of 1952-53.

Production in Europe is estimated at 1,700 million bushels, one of the largest crops ever produced in the area. Record or near-record crops were reported in a number of the principal countries of Western Europe. The main exceptions were Spain and the Netherlands, where drought in the former and floods in the latter reduced crops significantly.

The quantity of wheat available for export and carry-over from the four principal surplus - producing countries (United States, Canada, Australia and Argentina) during 1953-54 (July-June) are substantially larger than the 835 million bushels exported by these countries in 1952-53.

The aggregate supplies in these countries on January 1, 1954, for export and carry-over are estimated at about 1,915 million bushels. This is 3% above the previous record in 1943, and about one-fifth above the 1,575 million on January 1, 1953. Supplies are a record in the United States, a near-record in Canada, and are substantial in the other two countries.

Exports. While larger quantities of wheat are available for export this year, the total import requirements are less than last season, as a result of bigger supplies in most of the major importing countries, notably in the world's major importing area of Western Europe. Asia, the second most important outlet for the world's wheat exports, has had its third consecutive large crop. Although the estimate for Asia of over 1,600 million bushels is above the post-war (1945-49) average, import requirements are rather large in some Asiatic countries. Japan's requirements for 1953-54 amount to about 75 million bushels (40.5 million bushels were imported in 1952-53), principally because of the poor rice crop. Pakistan's requirements in 1954, however, are likely to be much smaller than in 1953, when about 27 million bushels of United States wheat were shipped or programmed to that country under an aid programme.

WHEAT AND FLOUR: EXPORTS BY MAJOR EXPORTING COUNTRIES, 1952-53 (JULY TO JUNE), WITH COMPARISONS

Countries	1934-38 average	1945-49 average	1950-51	1951-52	1952-53
			Million bushels		
United States ..	45	412	366	475	317
Canada ..	175	278	221	347	392
Australia ..	106	93	127	99	100
Argentina ..	122	67	103	30	30
Others ..	101	52	119	115	148*
Total ..	549	902	936	1,066	987*

* Preliminary.

In view of the larger supplies in most importing areas, total world exports of wheat this season may be some 10% or so below the total of approximately 987 million last season. United States exports are expected to be substantially below last season's total of 317 million bushels. Canadian exports this season are likewise expected to be below the 1952-53 exports of nearly 400 million bushels.

Argentina's 1953-54 (July-June) exports will be considerably above the 30 million bushels exported during this period a year earlier and will exceed 100 million bushels.

Australia's wheat exports thus far in the current marketing season are at about the same rate as a year ago, when the total for the year reached 100 million bushels. Production of 182 million bushels was somewhat lower than in 1952, but carry-over on December 1, 1953, was larger than a year earlier.

Winter grain prospects. Winter wheat acreage normally accounts for roughly three-fourths of the total wheat acreage in the Northern Hemisphere. In Europe, however, the proportion is 90% or more. The outlook for the winter wheat crop in Western Europe is generally good, though some damage is expected as a result of alternate freezing and thawing during January and early February. Some reseeding was necessary, especially in eastern parts of France and Germany and in Spain. Snow cover in those areas appears to have provided less protection to the crop than in other parts of Western Europe.

Increased winter wheat acreage is reported for a number of countries, especially France. If weather is favourable for spring seeding a good net increase over last year's acreage is expected for Western Europe. Wheat acreage harvested last year in that area was the largest of any recent year. Conditions in Yugoslavia were less favourable than in most European areas last fall, and as a result of prolonged fall drought the wheat acreage appears likely to be 5% to 10% less than in 1953.

In the major exporting countries of the Northern Hemisphere the acreage of winter wheat for harvest in 1954 is somewhat smaller than the 1953 acreage. The United States seeded acreage of 46.6 million acres is sharply below the 56.8 million acres seeded last year, reflecting the 1954 acreage allotment programme. Seeding conditions were mostly favourable, although delayed to some extent because fall rains were late. Winter wheat is of minor significance in Canada. The area seeded this fall is 7% less than for 1952 and growing conditions were near average. Fall seeded wheat in Asia is reported in good condition in most of the areas for which information is available, except that dry weather has had an adverse effect in some areas.

Cargill Crop Bulletin.

SOUTHERN RHODESIA

Tobacco. It is believed that in a few years' time this year's tobacco crop would be recognised as a milestone on the road to quality and competitive production, according to the Federal Minister of Agriculture, Mr. J. M. Caldicott, when he addressed the annual meeting in March of the Tobacco Trade Association of Rhodesia in Salisbury. He said he believed this year's crop was possibly of better quality than had been seen in Southern Rhodesia for very many years. The bulk of the crop had been reaped and the preliminary estimates of 117 million lb. was 12 million lb. greater than last year's record crop. The significant point was that this year's crop would have been grown on a smaller acreage than previously. While the improvement in yield and quality was partly due to the better weather conditions, it was also due, he believed, to a very great extent to the adoption by the growers of the recommendations of the Tobacco Research Board. He did not believe it would be any great exaggeration to suggest that the whole future of this industry lay to a great extent in the hands of the Tobacco Research Board. Within the Federation, the tobacco industry was second only to copper as an export. He was convinced the tobacco industry, important as it is in all three territories, would not be able to play its full part and maintain and increase its importance in the federal economy unless it

was dealt with on a federal basis. If a broad view were adopted he could see no reason why a great deal could not be accomplished towards the 'federalisation' of the industry.

INDONESIA

Palm oil. Indonesia's palm oil and palm kernel production in the first nine months of 1953 of 131,000 and 34,580 tons respectively represents an increase in both commodities of about 9% from the average monthly outturn of 1952. In 1952 Indonesia produced 160,900 tons of palm oil and 42,450 tons of palm kernels. The 1953 increase in production over previous years was due principally to increased plantings, although favourable weather was also an influencing factor.

Palm oil exports during January to October 1953 totalled 109,112 tons, an average of 10,911 tons per month. During the calendar year 1952 exports amounted to 132,491 tons, or a monthly average of 11,041 tons. The 1953 exports, therefore, were only slightly less per month than in the year before. As in 1952, the Netherlands, with 87,821 tons, or 80% of the 1953 exports, took by far the greater quantity. Palm kernel exports in 10 months 1953 of 37,987 tons represents an average monthly increase of about 10% from total 1952 exports of 40,975 tons. The decree exempting palm oil and palm kernels from the extra export duty was extended to include all of 1953. On December 5, 1953, a new decree extended the exemption through 1954.

SUDAN

Cotton progress report. We have received from the Ministry of Agriculture in Khartoum the following notes on the cotton progress report for March:

Sudan Gezira Board. With 4 kantars per feddan picked to the end of March, there is little cotton left to pick on Sakel blocks. X1730 cotton is expected to pick another ½ kantar per feddan.

Pump schemes, Sagias. Early March brought a flush of cotton and heavy picking, but picking fell off heavily in the second half of the month and many schemes are nearly picked out. The cold winter, especially the unbroken cold spell in November and December, is blamed for the falling off comparatively early in the season.

Gash. Picking in the Gash began late. Unfavourable weather at the beginning of March causing shedding of partly opened bolls, a sudden drying out of plants and severe bollworm infestation have caused the loss of much cotton.

Tokar. Shortage of soil moisture in the Delta caused a drying out of cotton which has led to a reduction in estimates.

Nuba Mountains. The cotton season closed at the end of March, when burning of cotton stalks and debris began. Final yields should soon be available.

ENGLAND AND WALES

Agricultural report. Agricultural conditions in England and Wales on April 1, 1954, have been summarised in a report by the Ministry of Agriculture.

The wintry conditions at the end of February continued during the first week of March, when snow fell in most parts of the country. A short spell of mild sunny weather followed, but soon gave way to dull, cold conditions. Temperatures rose somewhat in the third week, when rain fell in most areas. Conditions were changeable for the rest of the month. Rainfall was above average over much of England and Wales.

Autumn-sown crops. Wheat looked well generally, although rather backward in some areas. Damage by wheat bulb fly—generally slight—was reported from several localities. The true winter varieties of barley were recovering from the effects of earlier frosts, but other varieties sown in the autumn were badly checked and in several areas resowing or patching was carried out. Oats had wintered well and were generally satisfactory. Rye had also stood the winter well and was making good growth. Beans for stockfeeding suffered considerable frost damage, but reports indicated that many crops were recovering.

Spring cultivations and sowing. In most areas very little progress was made with spring cultivations until conditions became more favourable in the second half of the month. Some of the heavier soils were too wet to work and on the whole cultivations were less forward than usual for the time of year.

Satisfactory progress was made with sowing or lighter soils, but seed beds were difficult to obtain on heavy land and generally spring sowings were less forward than usual. In most areas germination was slow.

Potato planting and sugar beet. Except on lighter soils, the wet condition of the land hindered preparations for potato planting and, although good progress was made with the planting of early varieties in the second half of the month, this work was now in arrear.

The preparation of land for the cultivation of sugar beet was less forward than usual, particularly on the heavier soils. Some sowing had been carried out in a few eastern districts.

Some damage by frost to potato stocks is reported from several districts, but on the whole potatoes remaining in clamps were generally in good condition.

Pastures. On the whole leys sown last summer and autumn were generally well established, although slow to make growth owing to the cold and wet weather. Other leys were generally satisfactory but backward. Permanent pastures had made little or no growth as yet.

PHILIPPINES

Copra. Production of copra, coconut oil and desiccated coconut in the Philippines in 1954 is expected to exceed the 1953 output of 865,845 long tons copra equivalent by 10% to 15%. Coconut trees in the Bicol region have partially recovered from the severe typhoon damage of late 1952 and damage from typhoons in 1953 was slight. Prices during 1953 were attractive to the producer and very probably will have a stimulating effect on the 1954 production.

In 1953 production of coconut products was 7% below the 934,190 tons produced in 1952. The lower production last year was attributed partly to heavy typhoon damage late in 1952 in Southern Luzon, Masbate and Samar. The low prices during 1952 also had a depressing effect on production early in 1953.

Exports of copra and coconut oil were smaller in 1953 than in 1952, while exports of desiccated coconut increased. However, shipments to the United States, which took 52% of the copra and nearly all of the coconut oil and desiccated coconut, were up from 1952 in all three commodities. Total exports in 1953 included 592,267 tons of copra, 58,589 tons of coconut oil and 49,119 tons of desiccated coconut.

Prices of copra during 1953 showed the extreme fluctuation more or less characteristic of this commodity. The overall average domestic price of copra in 1953 was 36.04 pesos per 100 kg. ($183.09 per long ton) resecada in Manila against the average price of 24.11 pesos ($122.49) in 1952. Monthly average prices of copra ranged from a high of 44.42 pesos ($225.67) in March 1953 to a low of 30.27 pesos ($153.78) in June, while December 1953 copra prices averaged 38.54 pesos ($195.79).

The demand for copra during 1953 was somewhat stronger than in 1952, particularly in the United States. While there was no incentive to stockpile, buyers in the United States had reduced their stocks in 1952. Consequently, even though prices were higher in 1953, operations apparently were maintained at past levels and stocks were somewhat replenished.